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Contents

International Congress on Cosmic Radiation at Bagneres
de Bigorre: *Maurice M. Shapiro* 701

The Ninth International Congress of Genetics:
I. Michael Lerner 708

News and Notes

Eighth Annual Calorimetry Conference; Symposium on the
Role of Proteins in Ion Transport Across Membranes 710

Technical Papers

One-Step Preparation of C^{14} -Cyanide from Barium
Carbonate- C^{14} : *J. K. Jeans* 719

Evaluation of Oral Temperature Readings: *Francis L. Harmon* 719

Use of the Thymus Gland in Chicks to Elucidate Inter-
relationships Between Pteroylglutamic Acid and Biologically
Related Substances: *Gerald Brody* 720

Report of a Second Example of the Rh Agglutinin c^s , with
Some Comments on Its Relation to the Agglutinin f:
Alan Richardson Jones et al. 721

Fatty Acid Absorption and Chylomicrons: *H. Singer, J. Sporn,*
and *H. Necheles* 723

Comments and Communications

Methionine Content of Teosinte: *A. R. Patton et al.* 725

The "Great Fireball Procession" of 1913:
Alexander D. Mebane and C. C. Wylie 725

Book Reviews

*Exploration Hydrobiologique du Lac Tanganika and Expédition
Océanographique Belge dans les Eaux Côtières Africaines de
l'Atlantique Sud; The Biology of Paramecium;*
Low Temperature Physics: Four Lectures 727

Society for Social Responsibility in Science 3

Publications Received 10

Meetings & Conferences 12

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Society for Social Responsibility in Science

THE Society for Social Responsibility in Science, founded in 1949, an organization composed entirely of workers in the natural sciences, has issued a resolution rallying fellow scientists to action and exploring the "serious growth of fear" that inhibits free expression among scientists. The full text of the statement follows:

We the undersigned, members of the Society for Social Responsibility in Science, call on our fellow scientists to maintain and strengthen the spirit of free inquiry by clear and courageous public expression of considered opinions concerning the relations of science and society.

The spirit of free inquiry is essential to scientific research. It can only be maintained in this field if it is also applied to the many obstacles to the pursuit of truth that are now arising. Specifically we feel that scientists everywhere must concern themselves with and speak out on the problems of the maintenance of scientific integrity, the maintenance of channels of communication and travel and the proper direction of public support of research, as well as on the personal, moral problem of the end results of a scientist's professional work.

The Society for Social Responsibility in Science takes the view that each person has the individual and moral responsibility to consider the end results of his work as far as he can see them. This is a responsibility to society and implies a strong insistence on public expression of opinions. We find today a serious growth of fear of such public expression.

Free inquiry can disappear without any laws existing to suppress it. Fear of social disapproval can lead a so-

ciety to direct its thoughts only into predetermined channels. New truths will then escape us and they may be the vital truths for our time.

It is time that we learned to lose our fear of being "labeled" for saying things we profoundly believe in. This fear must be overcome if we are to preserve the trust and fellowship, the loyalty to truth, and the freedom of inquiry which we recognize as fundamental to science and to a high level of civilization.

Signed by: O. Theodor Benfey, president of the Society 1951-53, Haverford College; Anton J. Carlson, University of Chicago, past president of the AAAS; Charles A. Coulson, Oxford University, England; Leonard Dart, American Viscose Corporation; Arthur A. Frost, Northwestern University; Theodore B. Hetzel, Haverford College; Herbert Jehle, University of Nebraska; Kathleen Lonsdale, University College London, London; Franklin Miller, president of the Society, Kenyon College, Ohio; Stuart Mudd, University of Pennsylvania; Shigeru Oae, Institute for Scientific and Industrial Research, Osaka, Japan; Victor Paschkis, Heat and Mass Flow Laboratory, Columbia University; Edward G. Ramberg, Radio Corporation of America; Priyadarshan Ray, Chemical Society of India; Walter Scheider, Massachusetts Institute of Technology; William T. Scott, Smith College; Albert B. Stewart, Antioch College; and D. Robert Yarnall, Yarnall-Waring Engineering Co., Philadelphia (institutions listed for purposes of identification only).

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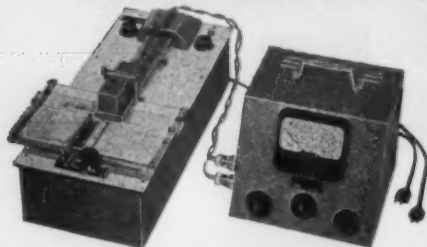
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International Congress on Cosmic Radiation at Bagnères de Bigorre

Maurice M. Shapiro

Nucleonics Division, Naval Research Laboratory, Washington, D. C.

THE International Congress on Cosmic Radiation held at Bagnères de Bigorre, near the Pic du Midi in the French Pyrenees July 6-12 proved to be an exceptionally well-planned and fruitful meeting. Organized by the University of Toulouse and sponsored by the International Union of Pure and Applied Physics with the support of UNESCO, the Congress attracted nearly two hundred physicists from twenty-three countries. Comparatively unhurried presentations and discussions were made possible by restricting the scope of the meeting to the field of "elementary" particles and high-energy interactions. The leisurely atmosphere contributed much to the success of the Congress.

New results on K-mesons and hyperons,¹ as well as reports on improved techniques for measuring their properties, were presented in six sessions which comprised the program of the first three days. These meetings, presided over by Professors Blackett, Leighton, Peters, Reynolds, Leprince-Ringuet, and Amaldi, were equally divided between papers on cloud chamber observations and those on experiments with nuclear emulsions. The fourth day was spent visiting the Observatory of the Pic du Midi where a notable attraction was the double cloud chamber installed by the École Polytechnique Laboratory. A morning session on high-energy interactions, presided over by Professor Bhabha, concluded the presentation of experimental results. The final three sessions were distinguished by the recapitulations of Professors Powell, Fretter, and Rossi, who deftly tied together many loose strands and outlined the pressing problems which remain.

This report attempts to summarize many of the results presented at Bagnères, with emphasis on the subject of unstable particles, to which the Congress was mainly devoted. It gives the impressions of a single observer, hence cannot pretend to do justice to all the noteworthy communications which were presented.

In summarizing the work on unstable particles, we shall first discuss those less massive than nucleons, and then the hyperons, charged as well as neutral.

¹ Unstable particles intermediate in mass between proton and deuteron. This group includes the V_s^0 which decays into a proton and π^- . A revised, rational nomenclature for the unstable particles was proposed by a group at Bagnères. The author had adopted the new notation for the present report, but then learned that some of the names were still under discussion by the recommending group. Accordingly, most of the familiar nomenclature is retained here; new names are used only in the absence of older ones.

K-MESONS

We shall use the term K-mesons to denote particles, whether charged or neutral, with masses intermediate between those of the π -meson and the nucleon. These are sometimes observed to decay in flight (V-events) and sometimes to decay or undergo nuclear capture after coming to rest (S-events). Alternatively, their presence may be deduced without evidence of decay or nuclear capture, from mass measurements on the primary track alone.

The existence of at least three types of K-mesons, subject to the following modes of decay, seems very likely:

$$\begin{aligned}\tau^+ &\rightarrow \pi^+ + \pi^+ + \pi^+ + Q & (1) \\ \pi^+ &\rightarrow \mu^+ + 2 \text{ neutral particles} + Q & (2) \\ V_s^0 &\rightarrow \pi^+ + \pi^- + Q & (3)\end{aligned}$$

(1) may be considered almost certain; and (2) and (3) are very probable. Most of our information about τ and π mesons comes from tracks in emulsions, whereas our knowledge of V_s^0 mesons derives from cloud chamber observations.

A fourth type of K-particle probably decays according to the scheme:

$$\chi^+ \rightarrow \pi^+ + \text{neutral particle} + Q \quad (4)$$

It appears possible that all four K-mesons have a mass close to $970 m_e$, but this is more firmly established for the τ -meson than for the others. In fact, one of the unsolved puzzles of the Congress was the question as to whether the various mass measurements on K-particles can be reconciled with a single mass, i.e., that of the τ -meson.

V_s^0 -Mesons. Convincing evidence for a neutral particle with mass indistinguishable from that of the τ was presented by Thompson of Indiana University. He found a group of neutral V-events characterized by the decay scheme (3) and the energy release 214 ± 5 Mev. This Q value implies a mass of $971 \pm 10 m_e$ for the parent V_s^0 meson.² Barker of Manchester, Bridge of MIT, and Gregory of École Polytechnique reported cloud chamber observations consistent with Thompson's.

An estimate of the lifetime of V_s^0 particles was

² κ (kappa)-mesons should not be confused with the more inclusive category, K-mesons, of which the kappas are a special class.

³ The suggestion of a " V_s^0 " which decays into two light mesons, probably pions, had previously been made by Butler and his collaborators of Manchester. However, the more definite quantitative properties which could be assigned to the Indiana V-events led to the designation V_s^0 .

given by Astbury of Manchester, who used the symbol " V_2^0 " to designate all neutral V-events which do not conform to the V_1^0 scheme. These may, however, be presumed to consist largely of V_2^0 mesons. The mean life of $1.7 \pm 0.6 \times 10^{-10}$ was based on an assumed Q value of 160 Mev. Since, however, the calculated lifetime decreases with increasing Q , the best value for V_2^0 mesons would seem to be lower than the one given. On the other hand, the selection of long tracks, which permit a better determination of momentum, tends to introduce a bias against the longer-lived particles which decay near the bottom of the cloud chamber.

There does not yet appear to be good evidence for the 3-body decay of a neutral K-meson (or τ^0) into two charged and one neutral pion.

Charged K-Mesons. Knowledge about the nature of these particles stems mainly from two sources, direct mass measurement on the primary tracks and the identification and momentum distribution of their secondaries. We shall first discuss those K-mesons which decay with the emission of a single charged secondary, then we shall briefly review the better known τ -mesons.

Masses of Charged K-Mesons. Mass measurements on charged particles observed in nuclear emulsions differ according as the particles come to rest or are relatively fast. In the former case (S-events) an important parameter is the residual range, as a function of which one measures the changing ionization or multiple coulomb scattering. For fast particles one must rely on the latter two quantities, which usually are nearly constant along the available length of track. At the Bagneres Congress, six groups presented results on K-particles which stopped in emulsions—Bristol, Bombay, Brussels, Cornell-Rochester, Milan-Genoa, and Paris. Mass determinations on fast K-mesons emitted from stars and "jets" were made at two laboratories, Bristol and the Naval Research Laboratory in Washington.

Menon and O'Ceallaigh, of Bristol, found that if one considers the measurements on the primaries alone, these are consistent with a unique mass of 1100 m_e for stopped charged K-mesons (other than τ).⁴ Similar results, suggesting masses in excess of 1000 m_e , were reported by Bonetti for the Milan-Genoa group. On the other hand, measurements which strongly indicate a mass close to that of the τ were described by Mrs. Dilworth (Brussels), Peters (Bombay), Crussard (École Polytechnique, Paris), and Kaplon (for the Cornell and Rochester groups).

Reviewing the mass distribution of fast meson-shower particles observed at Bristol, Perkins stated that the results are consistent with a single mass of about 1200 m_e . He considered it unlikely that it could be less than 1100 m_e , citing the fact that only one value as low as $955 \pm 120 m_e$ was observed. Shapiro reported the latest mass measurements at NRL on moderately fast ($0.5 < \beta < 0.75$) K-mesons created in fundamental interactions (i.e., stars consisting of

⁴ See, however, discussion of secondaries below.

thin or gray tracks only). A mean value of $1115 \pm 90 m_e$ was deduced from the three long tracks in which the ionization exceeded twice the minimum. Thus good precision could be expected both in velocity, from ionization, and the quantity $p\beta$, from scattering. A single example with a mass of $895 \pm 140 m_e$ was also reported.

In cloud chambers, mass estimates on K-mesons, whether in V-events or S-events, have hitherto been subject to rather large error. A notable improvement has been introduced with the double cloud chamber arrangement of the École Polytechnique. The tracks are magnetically bent in the upper chamber, and the particle has a good chance of stopping in the lower, multiplate chamber, thus yielding range as well as momentum. In addition, the nature and interactions of the secondaries can be studied in the lower chamber. Lagarrigue cited four mass determinations on S-primaries, the mean of three of these being $922 \pm 41 m_e$. It is interesting that the cloud chamber results of Leprince-Ringuet's group agree with the emulsion results from the same laboratory in assigning a mass $< 1000 m_e$ to the stopped K-mesons.

Secondaries of Charged K-Mesons: Evidence for Kappa and Chi Mesons. That some of the charged secondaries are mu mesons appears definitely established. The best recent example, described by Renardier, was found in a stripped-emulsion stack at Bristol. The secondary had been followed through 18 layers with a track length of 3 mm in each, and its mass was found to be $203 \pm 8 m_e$. Several additional muon secondaries were observed at Bristol, and one each at Milan and Paris. These muons show a wide spread in momentum, indicating a three-body decay. Thus as Menon pointed out, the existence of a kappa meson which disintegrates according to scheme (2) seems fairly sure, although the nature of the neutral particles is still uncertain. He stated that the mass of the kappa very probably exceeds 1000 m_e .

Menon also asserted that there is strong but not yet decisive evidence for the presence of π mesons among the secondaries of K-particles. At least three good examples of pions have been found. These, as well as a few more apparent pi secondaries, have $p\beta$ values (from multiple scattering) which cluster close together with a weighted mean of 179 ± 7 Mev/c. These results led the Bristol group to suggest the existence of a chi meson which, unlike the kappa, undergoes 2-body decay. There are indications that the chi mass is somewhat less than 1000 m_e , and that the mass of the neutral secondary is less than 300 m_e . Thus one is tempted, at least provisionally, to identify the chi with the tau, and to assume that it undergoes an alternative mode of decay in which only one charged pion is emitted rather than three.

From cloud chamber observations on charged V-events and S-events,⁵ further data are available on

⁵ These terms refer to phenomenological appearance, not to definite particles. Thus, V-events and S-events may, for example, involve hyperons, as well as K-mesons. However, the discussion in this section is confined to the evidence bearing on K-mesons.

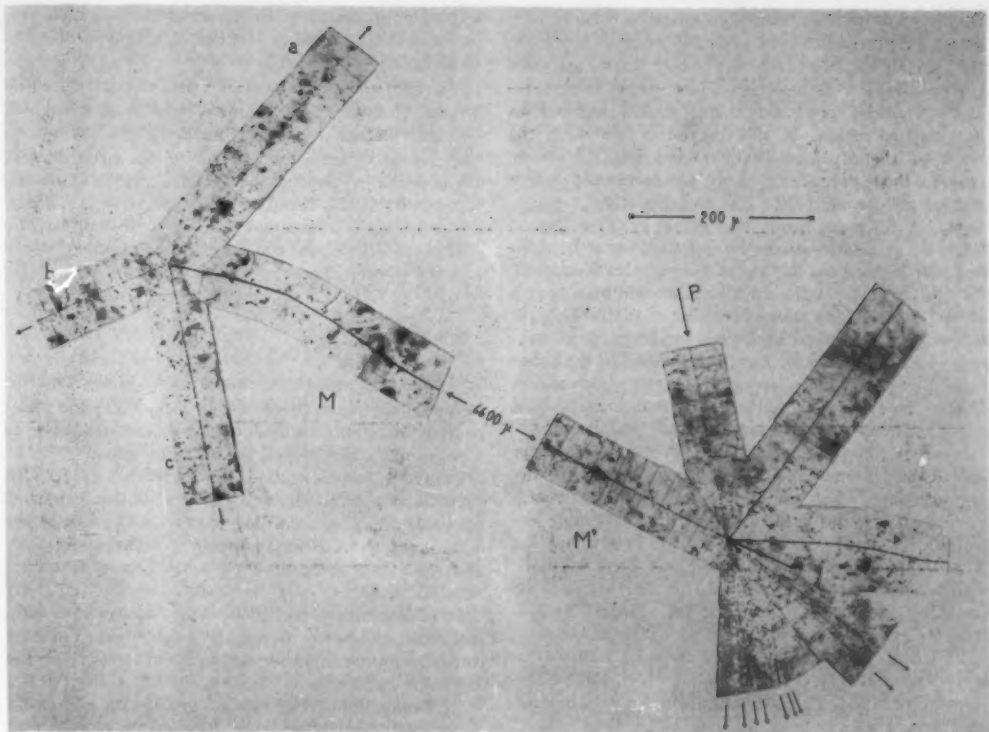


FIG. 1. Emission of a Tau Meson from a Shower Star. This photomicrograph shows the first published evidence for the direct production of a tau meson (singly charged particle of mass $970 m_e$) in a high-energy nuclear disintegration. The incident particle P collided with a target nucleus in a sensitive photographic emulsion, 1200 μ thick, exposed to the cosmic radiation at an altitude of 30 km. The tau particle M' came to rest after traversing about 7 mm of emulsion; it then decayed into three pions, a, b, c. In addition to the relatively slow heavy meson, a shower of fast particles, attributable mainly to π -mesons, was also generated. Courtesy of M. Ceccarelli, N. Dallaporta, M. Merlin, G. Quarenli, and G. T. Zorn, University of Padua. (*Il Nuovo Cimento*, 10, 681 [1953]).

the K-mesons and their secondaries. Thus Butler observed that the V^+ particles seen at Manchester are probably a mixture of kappa and chi mesons. Most of their secondaries have a transverse momentum consistent with ~ 200 Mev/c, but some have nearly one-half of this value. Leighton stated that the peak of the mass distribution for the V^+ particles studied at the California Institute of Technology, occurs at $\sim 950 m_e$, and the transverse momenta are distributed around 150–200 Mev/c. Thompson said that the Indiana data permit the assignment of an upper mass limit of 1200 m_e , and lower limits of 970 or 940 m_e , respectively, for assumed decay into pion or muon.

Rossi noted that charged secondaries of S-events in the MIT multiplate cloud chamber have been followed through 950 g/cm² of Pb—approximately 6 mean free paths—without any clear indication of a nuclear event. Since these secondary particles are light⁶ mesons, they are very likely to be muons, but the possible occurrence of pi secondaries in cloud chamber S-events cannot be

ruled out. The MIT S-secondaries have a momentum distribution which clusters around 200 Mev/c.

Observations bearing on the nature of the neutral secondaries are scarce. There was special interest, therefore, in the evidence presented by Rossi that photons with 100–200 Mev energy are associated with some of the S-decays. Four cases have been observed in the MIT cloud chamber in which small electron showers appear about 180° from the direction of emission of the charged secondary. In all four examples, the electron tracks lie within a 15° cone, and in two of these, within 5°. This argues against a π^0 secondary, since the most probable spread in the electron progeny would then be about 30°. Thus the neutral secondary in these S-events is probably a gamma ray. However, this cannot be true of all the S-events unless the energy of the gamma ray in those is very low.

Negative K-Mesons. Since evidence for negative K-mesons has hitherto been elusive, one of the striking communications was that of Peters, who described four examples of K-mesons captured by nuclei after coming to rest. The observations were made by the

⁶ The term "light meson" is here used collectively for pions or muons.

Bombay group in an "emulsion block" consisting of a set of stripped emulsions, each 600 microns thick. Of the four events, two involved primary tracks too short for good mass determination. However, each of these slow primaries produced a star which included an outgoing pi meson. In the remaining two stars, the track of the captured heavy meson was 2.5 cm or longer, thus permitting mass measurements which yielded values of 1010 ± 150 and 840 ± 200 , respectively. A different result was given by Friedlander, who told of an extensive and systematic search which had been carried out at Bristol for negative K-mesons. No definite evidence for such particles had been found. Powell suggested a possible explanation for this result: if the K^- , when captured, produces an observable star in only a small fraction of cases, as the muon does, this would help account for the observations. Schein reported that several possible examples of negative K-mesons had been observed at Chicago.

τ -Meson. The properties of this K-meson are better known than those of the others, largely because its decay into three charged light mesons yields a wealth of quantitative information from any favorable example of τ decay. There is now little doubt that the three light mesons are all pions. The τ mass is known within a few electron masses to be $967 m_e$, and its mean life exceeds 10^{-10} sec. For the τ decay, Amaldi reported an energy release of 76 ± 1.7 Mev and Peters, 72.2 ± 0.8 Mev. Estimates of the ratio of τ to π production were also given: Amaldi, 3.5×10^{-3} , and Peters, 1.0 ± 0.7 per cent. The latter figure was for a balloon exposure at geomagnetic latitude 19° .

Observations of τ -mesons in Wilson chambers are still unusual: two were described at Bagneres. A τ for which each of the three secondaries traversed at least four plates of the cloud chamber at Washington University was reported by Sard. Another, possibly the first tau demonstrated to have negative sign, was observed, according to Leighton, in the new Pasadena 4-chamber arrangement. The experimental results on the τ -meson were capped with a theoretical discussion by Dalitz of Birmingham on the modes of decay of this particle which are expected according to the pseudoscalar, vector, and pseudovector theories.

Direct Emission from Stars. Examples of the emission of identifiable types of K-mesons from stars have been slowly accumulating. Thus, the direct emission of kappa mesons was cited by Bonetti of Milan. The group at Padua has observed the ejection of a τ -meson from a star (Fig. 1). Independent evidence for the emission of K-mesons from stars has come from Bristol, Oslo, and NRL. A large fraction of the Bristol observations were made on "jets." The Washington group concentrated on stars lacking evaporation tracks and hence attributable to "fundamental-type" collisions.

HYPERONS

In the domain of unstable particles intermediate in mass between proton and deuteron, two developments are particularly noteworthy—the evidence for charged

hyperons, including those observed in V-particle cascades, and the growing number of emulsion observations of V_1^0 decays.

V_1^0 Particles. The neutral V_1^0 is of course the best known of these "super-nucleon" particles, nearly all the information deriving from cloud chambers until very recently. Armenteros reviewed the properties of these particles. Among the various groups reporting V_1^0 results at the Congress—Manchester, MIT, Pasadena, Indiana, Princeton, Ecole Polytechnique, and Göttingen—there was consensus on the mode of decay and the Q -value, i.e.,

$$V_1^0 \rightarrow P + \pi + (37 \pm 2) \text{ Mev} \quad (5)$$

Page of Manchester reviewed the lifetime measurements on the V_1^0 and arrived at a mean life of $3.3^{+0.9}_{-0.5} \times 10^{-10}$ sec, based on what he considered the best available data, those of Cal Tech, MIT, and Manchester. Bartlett's method of calculating the lifetime was generally accepted as the most suitable.

Leighton remarked that the Pasadena group still regards as possible the existence of another group of particles decaying according to scheme (5) except for a different Q -value and possibly a different lifetime. Cal Tech has observed a concentration of Q -values near 75 Mev.

It is also noteworthy that many laboratories have observed occasional examples of neutral V-decays which seem incompatible with either the V_1^0 or the V_1^0 described above.

V^0 Production. The rate of production of neutral V-events (of all kinds) increases rather slowly with the energy of the associated shower, according to Deutschmann of Göttingen. On the other hand, Reynolds reported a rise of about a factor of 7 between 2 and 20 Bev. Deutschmann estimated that only 20 per cent of the V^0 particles decaying in a cloud chamber are actually observed, and concluded that one V^0 is produced for every 8 ± 2^2 showers. He remarked that owing to the large fraction of V^0 events which are missed, there is no decisive evidence against Pais' suggestion that V^0 particles are produced in pairs. Newth of Manchester stated that in showers with energy $\sim 5 \times 10^{10}$ ev, V^0 are produced at a rate about 3 per cent that of charged shower particles, and at least one-half of the V^0 are V_2^0 . Thompson found a similar relative rate of V_1^0/V_2^0 production, for energies between 10^9 and 10^{10} ev. Reynolds reported on the energy distribution of the V_1^0 particles. At least 25 per cent of Princeton's V_1^0 , he said, have an energy less than 400 Mev.

Schein of Chicago described several examples of apparent V_1^0 production by 227 Mev π -mesons. He cited experimental precautions and tests which indicate that the observed events are neither neutron-induced stars nor due to back-scattered pions originating in the π -beam. However, he pointed out that further work will be required before the V_1^0 interpretation of these events can be considered conclusive.

V_1^0 in Emulsions. After several years in which only

one or two isolated V^0 -events had been observed in emulsions, a surprising total of some twenty apparent examples found in this medium were reported to the Congress by Yasin of Bristol, Amaldi of Rome, Peters of Bombay, Bonetti of the Milan-Genoa group, and Teucher of Bern. The necessity of distinguishing between true V^0 decays and phenomenologically similar events such as 2-prong stars due to neutrons, was generally recognized. Some of the reported examples of V^0 were subject to the criticism of lacking sufficiently rigorous evidence for this distinction. However, in a substantial number of the observations, the secondary products were identified as proton and pion, respectively, and the Q -value agreed with that of the V_1^0 (~ 37 Mev) within experimental error. Admitting that one can hardly be sure of the V^0 identity of any isolated event, a systematic study can lead to reliable data on V^0 in emulsions. Thus, as Powell observed, if a collection of 2-prong stars has been examined for proton-pion pairs, and the Q -values computed, assuming 2-body decay, then the appearance of a closely bunched set of Q -values suggests that one is in fact observing a homogeneous group of V^0 -type decays.

V^0 in Nuclear Fragments. The emission of an unstable nuclear fragment which apparently contained a V_1^0 particle, first noted by Danysz, has also been reported from Imperial College and the École Polytechnique. Upon coming to rest the fragment decays with the emission of a proton, or alternatively of a proton and pion. Crussard described the Paris observation, and Ney reported a similar event observed by Freier at Minnesota. Sard of Washington University in St. Louis summarized the theoretical considerations of his colleagues Cheston and Primakoff on bound V -particle decay. They estimate the mean life for "nonmesonic" decay of V -particles embedded in light nuclear fragments as 10^{-11} to 10^{-12} sec. This time is sufficiently long to allow the fragment to come to rest. They also discuss the possibility of a " V -deuteron," a neutron bound to a V -particle, which would decay in 10^{-10} sec according to one of the schemes

$$\begin{aligned} &\rightarrow p + n + 175 \text{ Mev} \\ \text{"V-deuteron"} &\rightarrow p + p + \pi + 35 \text{ Mev} \\ &\rightarrow p + n + \pi + 35 \text{ Mev} \end{aligned} \quad (6)$$

Although no observation of a charged V -deuteron was reported at the Congress, the Bombay group has measured a 2-prong event which, if correctly interpreted as a V^0 event, may represent a "neutral V -deuteron" which decays into a deuteron and a π with a Q of ~ 90 Mev.

Charged Hyperons. Evidence for singly charged hyperons was of three types: tracks in emulsions of slow (stopped) and fast particles; and V -particle cascades in cloud chambers. Three observations were discussed by Levi-Setti of Milan. The first two had slow primaries 16 mm and 1.25 mm long, respectively, with mass values of $2370 \pm 280 m_e$ and $2300 \pm 780 m_e$, respectively. The fast singly charged secondary in each case left the emulsion after too short a path to permit identification. However, from the grain density

of their tracks it was inferred that they are probably light mesons. The third example had a primary track of 0.9 mm, too short to allow mass estimation, but its secondary track, 1.67 mm long, could be identified as due to a proton which terminated in the emulsion. Assuming a decay of the type

$$H^+ \rightarrow P + \pi^+ + Q \quad (7)$$

a mass of $2320 m_e$ and a Q of 115 Mev were calculated for this event.⁷

An example of a charged hyperon which decays just before it comes to rest with the emission of π^+ was analyzed by Peters, Lal, and Yash-Pal. The primary track was 19.3 mm and the secondary 14 mm long, the mass evaluation being $2520 \pm 400 m_e$ and $330 \pm 60 m_e$, respectively. The event can be interpreted in terms of a decay scheme symmetric with respect to (7), i.e.,

$$H^+ \rightarrow \text{neutron} + \pi^+ + Q \quad (8)$$

where $Q = 135 \pm 35$ Mev.⁸ A decay of a hyperon in flight with the apparent emission of a pion was reported by Ceccarelli and Merlin of Padua.

Shapiro reported the following observation by the group at the Naval Research Laboratory in Washington. A moderately fast singly charged particle of mass $2560 \pm 500 m_e$ was emitted from a fundamental collision apparently of the p - p type. Its track, 18.6 mm long, displayed an ionization of 2.25 times the "plateau" value, hence well above the insensitive region of minimum ionization. Thirty-four tracks of protons and pions of comparable lengths and grain densities were used for calibration.

V -Particle Cascades. A phenomenon of exceptional interest is the V -particle cascade observed in cloud chambers. Until recently there has been but one example, that of the Manchester group. Butler reviewed the characteristics of this original event: somewhat below and near the decay point of a V^- occurs the vertex of a V^0 . The event can be interpreted as the decay of the charged V into a V^0 and a light charged meson. It was not possible, however, to identify the type of V^0 . Leighton reported three new examples observed at Pasadena. These provided important evidence for the genetic relation between the V^- hyperon and the V^0 ; moreover, the V^0 is identified as a V_1^0 , i.e., one which decays according to (5). The charged secondary is a π or μ meson. Thus the following 2-body decay scheme was suggested:

$$V^- \rightarrow V_1^0 + (\pi^- \text{ or } \mu^-) + Q \quad (10)$$

Selection Rules. A timely contribution by Michel of

⁷ The decay of a charged hyperon into a proton, observed in one of the Pasadena cloud chambers, was reported at the Rochester Conference in December, 1952. A similar event has been observed by Bridge and Annis.

⁸ The NRL group, Kling, Seeman, and Shapiro, have recently observed an example similar to that of Peters. They suggest, however, as an alternative to scheme (8), the mode of decay

$$H^+ \rightarrow V_1^0 + \pi^+ + Q \quad (9)$$

Support for (9) is provided by cascade V -particle events which led the Pasadena group to postulate scheme (10) (see below). Rather direct evidence thus exists for the emission of a V_1^0 as a neutral decay product of a hyperon, whereas there seems to be no corresponding evidence for a secondary neutron.

Paris was a list of selection rules which must be obeyed by any proposed decay scheme.

HIGH-ENERGY INTERACTIONS AND MESON PRODUCTION

Kaplan of Rochester reported that there is apparently no strong dependence at very high energies ($\sim 10^{13}$ ev) of meson-shower multiplicity on the size of the target nucleus. Hoang, of the École Polytechnique, described a study of "jets" made in collaboration with the Brussels and Milan groups. When the shower multiplicity is plotted against total energy, the showers appear to separate into two groups, one in which the multiplicity goes up steeply with energy, and another in which it increases very slowly. One interpretation offered is that the high-multiplicity showers arise in "head-on" collisions, and the other showers in glancing collisions in which only a fraction of the energy in the CM system is expended in meson production. An alternative explanation is that the nature of the primary generating particle differs for the two categories. Bhabha of the Tata Institute and Janosy of Budapest cautioned that additional data are required to establish a clear separation into two groups.

Jets and K Production. Mulvey of Bristol described an extremely energetic jet, the core of which had been followed through twenty emulsions. A study of electron pairs in the core led to a ratio of 0.25 ± 0.1 neutral pions to charged shower particles. Since the ratio of neutral to charged pions is approximately 0.5, the ratio of charged pions to all charged shower particles was inferred to be 0.5 ± 0.25 . Of the remaining 50 per cent of shower tracks in the jet, ~ 10 per cent were attributed to knock-on protons and ~ 40 per cent to K-mesons.

Haber-Schaim of Rehovot, Israel, presented theoretical considerations on the relative production of K- and π -mesons according to Fermi's theory, under the alternative assumptions that only pions are Yukawa particles, and that K-mesons are also nuclear-force particles.

Nucleon Pairs, Stars, Jets. Schein called attention to the expected creation of nucleon-antinucleon pairs in collisions of sufficiently high energy, and reported a search for negative protons and their annihilation. No such evidence was found. Cosyns of Brussels found some 200 directionally correlated pairs of mesons, protons, or mesons and protons emerging from stars. Of these he considered that only ten were likely to be accidental. Moreno of Rome studied a group of jets, assuming independence of energy and angular distribution of the secondaries in the CM system. Calculations were made according to the Fermi and Heisenberg theories of multiple meson production.

Multiple Meson Production. Bhabha presented an alternative theory in which the production depends in a crucial manner on the meson field of the nucleon. Assume that a nucleon consists of a massive center of radius ρ containing a fraction $(1-\epsilon)$ of the nucleon mass, plus a surrounding meson field which contains

the rest of the mass, ϵM . In a collision of two nucleons the fraction of energy which goes into meson production depends on ϵ and ρ . If the meson field is due to pions alone, ϵ cannot exceed 0.1. If heavier mesons (e.g., $\sim 1000 m_e$) are considered to be nuclear-force particles, then ϵ may be as large as ~ 0.5 . The ratio of types of particles produced depends strongly on ϵ . According to Bhabha's theory, the energy needed to create a pair of heavy mesons is higher than in Fermi's theory.

Underground Phenomena. A review of cosmic ray phenomena underground was given by Amaldi, in which the cross sections for production of neutrons, stars, penetrating showers, and pairs of penetrating particles were examined critically. The nature of the last of these phenomena had for some time eluded explanation, as the cross section for their production appeared to exceed that of stars observed underground, and this precluded their interpretation as particles originating in penetrating shower-stars. With a large array of counters, Amaldi and his collaborators found that the cross section for production of penetrating pairs is smaller than that for the generation of penetrating showers. Thus the underground pairs need not be considered a special phenomenon, but their origin can be ascribed to shower stars generated by the electromagnetic interaction of mu mesons with nuclei.

Lovati described underground experiments of the Milan group using cloud chambers. Their results on penetrating pairs are compatible with Amaldi's. They also found that the penetrating particles in question are strongly interacting, therefore not muons. Because the muon component is often accompanied by strongly interacting particles, it is difficult to be certain that a given interaction observed underground is due directly to a muon.

PROGRESS IN METHODS OF MEASUREMENT

Among recent instrumental advances, two were considered exceptionally noteworthy. One of these, the double cloud chamber of Leprince-Ringuet's group at the Pic du Midi, has been described above. Details were given by Johnston and others of the Paris group. A similar arrangement has been set up by the Princeton group under Reynolds. The other major development is the successful application of blocks of stripped emulsion, notably by the Bombay group, to the study of heavy unstable particles. Techniques for mounting "pellicles" on glass before development, so as to minimize swelling and distortion, had been developed at the Naval Research Laboratory in Washington, and at Bristol. At the Congress, these techniques were described by Fowler and discussed by Shapiro. Peters told of an accurate, though laborious, method of microscopic alignment which expedites the following of tracks from one emulsion layer to the next.

Cerenkov Detector for Heavy Mesons. A promising method of enhancing the detection efficiency for heavy mesons, and measuring their lifetime, particularly in

S-events, was reported by Hyams of Manchester. A cloud chamber contains a set of Pb plates and a Cerenkov detector. Above the chamber is a Pb absorber of variable thickness, another Cerenkov detector, and some counters. The apparatus is designed to discriminate against electrons, light mesons, and protons, leaving a reasonable chance of detecting heavy mesons.

Other Cloud Chamber Techniques. Braddick described photometric measurements of ionization in cloud chambers. The relative transmissions (photographic densities) of two tracks were used as an index of relative ionizations. Barker discussed the methods of cloud chamber measurement employed at Manchester. Thompson described the new magnetic chamber at Indiana, designed for studying high-energy processes, and the procedure used to measure track curvature with precision. The upper limit of detectable momentum is 5×10^{10} ev/c. Chanson of the École Polytechnique, Bridge of MIT, and Ballario of Rome discussed cloud chamber techniques in use at these laboratories.

Relativistic Rise in Ionization Loss in Emulsions. Shapiro reported an investigation, in collaboration with Stiller at NRL, of the relativistic rise in ionization loss in nuclear emulsions. It was found that the "plateau" value of ionization lies 14 ± 3 per cent above the minimum. At energies γ between 10 and 100 rest masses their data are entirely consistent with the slow rate of rise predicted by the Fermi-Halpern-Hall-Sternheimer theory. At extremely high velocities, the ionization saturates at $\gamma > 100$ and maintains its plateau value at least as far as $\gamma = 3500$. Electrons, mesons, and protons show the same variation in AgBr grain density with velocity.

Multiple Scattering. D'Espagnat of Paris presented an analysis of the multiple coulomb scattering technique in emulsions with a discussion of "noise" elimination, and of optimum cell lengths for minimizing error. For the identification of stopped particles in emulsions, the variation of multiple scattering with residual range makes it desirable to employ a "constant-sagitta" method of scattering which utilizes the range-energy relation for known particles. This technique has been employed at Brussels, Milan, Paris, and Bombay. Mrs. Dilworth-Oechialini explained the basic advantages of the constant-sagitta method: it is simpler to compute the straight average of the second differences; the "noise level" is practically independent of the (vary-

ing) cell length; and cutoff for large single scatters is determined over the whole length of track once for all.

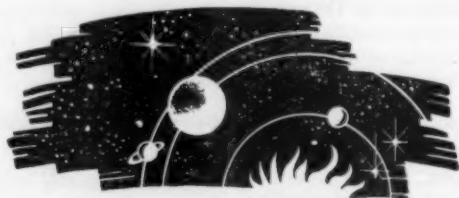
Gaps, Photoelectric Measurement in Emulsions. An alternative to the scattering vs. range method for stopped tracks is, of course, that of ionization vs. range. For the dense tracks of arrested particles, however, grain counting is impractical and one must rely on other means of measuring the ionization. Two methods were described to the Congress. One, involving measurements on the gaps in dense tracks, was analyzed in detail by O'Ceallaigh who collaborated with the Bristol group. He measured mean lengths of gaps exceeding a given lower limit (e.g., $\sim 0.5 \mu$), having determined that the mere counting of gaps is not a very useful procedure. A second method, which has been used successfully at the École Polytechnique, is a photoelectric instrument described by Morellet and Kayas. This apparatus appears to represent a notable advance in the art of photoelectric track measurements, pioneered by Demers, Blau, von Friesen and Kristiansson, and Ceccarelli and Zorn.

"Erosion" by Hypo. Oechialini discussed the problem of "erosion" of surface layers by hypo solutions—a defect sometimes encountered with thick emulsions, which require very long fixing times. The addition of Ag salts to the thiosulfate bath mitigates the trouble.

Meeting concurrently with some sessions of the Congress, was a conference on Astrophysical and Geophysical Correlations. A lucid summary of the proceedings of that conference was given by Vallarta of Mexico during the final session.

In their concluding remarks, President Blackett and Secretary Leprince-Ringuet reviewed the advances reported at Bagnères and pointed to the wide horizons which lie ahead in cosmic-ray research.* A rising vote of thanks was tendered by the Congress to those who had labored so effectively for its success, notably Prof. Leprince-Ringuet, Dr. Gregory and Dr. Peyrou, and the staff of the École Polytechnique, Director Rösch of the Pic du Midi Observatory and his staff, and Dr. Daudin who had organized the auxiliary meeting on astrophysical correlations.

*The reader who wishes background information on the new unstable cosmic-ray particles is referred to a review article by G. D. Rochester and C. C. Butler in *Reports on Progress in Physics*, **xvi**, 364 (1953). A useful bibliography is included.



The Ninth International Congress of Genetics

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THE Ninth International Congress of Genetics was held in Bellagio on the Lake of Como August 23-31, 1953. It was the second post-war Congress in a series beginning with the 1899 London meeting, which anticipated by a year the rediscovery of the laws of Mendel. Much has happened in science in the half-century separating the first and the latest of the Congresses, particularly in genetics, which in the course of this period has come to occupy the key position in the community of biological disciplines. This fact was amply illustrated by the program of the Ninth Congress, which was characterized by a widened emphasis on the application of genetic methods and genetical thought to an ever increasing variety of biological subjects.

Statistical comparisons provide but a poor reflection of the growth of an institution such as a scientific congress. Nonetheless, it should be recorded that the number of participants at Bellagio was the highest in twenty-five years, with 873 registered, as against 562 at the 1932 meeting in Ithaca, New York, about 600 in Edinburgh (1939), and 610 in Stockholm (1948). The number of countries represented was 36, lower than the 52 nations at Edinburgh, at least in part because of the lack of representation at Bellagio of the Soviet-dominated countries. The number of communications presented (347) was, however, higher than the respective figures of 219 (Ithaca), 331 (Edinburgh), and 179 (Stockholm), at the Congresses immediately preceding the Ninth.

The organization was vested in a group of Italian biologists, with the Executive Committee consisting of Alessandro Ghigi (Bologna), Chairman; Claudio Barigozzi (Milan), Secretary; Giuseppe Montalenti (Naples), Editor of the *Proceedings*; and Adriano Buzzati-Traverso (Pavia); Luigi Cavalli-Sforza (Milan); Silvio Ranzi (Milan), and Sergio Tonzig (Milan). The Secretariat included R. Ceppellini (Milan), G. E. Magni (Pavia), and L. Semenza (Milan). International congresses do not run themselves. The smooth functioning of a congregation of representatives of six continents was evidence of the months of careful planning and hard work by the Secretary, his staff, and many others.

Richard B. Goldschmidt, Professor Emeritus of Zoology at the University of California, Berkeley, was officially chosen as the President of the Congress, following other illustrious names which on previous occasions have filled this office (T. H. Morgan at

Ithaca; N. I. Vavilov, for whom F. A. E. Crew served in Edinburgh; H. J. Muller at Stockholm). His Presidential Address on "Different Philosophies of Genetics," which opened the proceedings, was a review and comparison of what he designated as the statistical and physiological approaches to genetics, the interplay between which is responsible for the important advances in the subject.

The Vice-Presidents of the Congress were Sir Ronald Fisher (Britain), A. Ghigi (Italy), H. Kihara (Japan), and Ö. Winge (Denmark).

The scientific program was arranged in three parts: plenary sessions, special sessions, and demonstrations. The first of these were devoted to seven symposia on general topics of greatest current interest in the field, each consisting of several invited papers:

1. The bases of heredity (E. Lewis, Mather, Lerner).
2. Genetic mechanisms and mutations (Dulbecco, Pontecorvo, Demerec, Stubbe).
3. Cytological mechanisms (Camara, Oksala, Müntzing, Matthey).
4. Developmental mechanisms (Sonneborn, Hadorn, Stern, Barigozzi).
5. Evolutionary mechanisms (Dobzhansky, Buzzati-Traverso, Ford, J. Clausen).
6. Human genetics (Penrose, Sjögren, Glass, Montalenti).
7. Applied genetics (Lush, Brieger, Frankel).

The special sessions included 39 meetings, at which contributed papers were delivered, together with some invited papers not included in the symposia. The number of sessions devoted to each subject was as follows (the names being those of the invited speakers):

Blood groups	2
Evolution	5 (Fisher, Jucci, Darlington, Haldane)
Human genetics	5 (Nachtsheim, Gianferrari)
Mutations	4 (Gustafsson)
Animal genetics	3 (Dunn, Waddington, Grüneberg)
Applied genetics	2
Cytology	5 (Chiarugi)
Genetics of microorganisms	2
Plant genetics	2
Quantitative genetics	2
Biochemical genetics	1
Cellular physiology	1 (Caspari)
Cytoplasmic heredity	1

Disease resistance	1
Human population genetics	1 (Gini)
Phenogenetics	1
Sex	1

The demonstrations were 41 in number, and an exhibition of scientific instruments and books was held in conjunction with them.

It is impossible, of course, to single out among the several hundred papers presented those of greatest significance. The importance of much of the material presented can become apparent only with time. No one person could have attended all the sessions, with as many as eight meetings simultaneously. Genetics has enlarged its domain to such a degree that there exists probably only a handful of "compleat" geneticists who would feel sufficiently at home in the various subject-matter sections to be able to form a competent judgment on the comparative merits of the contributions in all of them.

Nevertheless, it can be said that the most significant trend at the Bellagio Congress was the virtual abandonment of the gene in the classical sense as the object of study. Both the statistical and physiological approaches, to follow the line of distinction laid down by President Goldschmidt, have instead turned their attention to the properties and functions of more complex systems. Continuous variation on both the genotypic and the phenotypic levels, gene and character interaction, integrating developmental and evolutionary mechanisms, biochemical pleiotropy, mutations of polygenic systems, population structure, epigenetic evolutionary processes—these were the topics which aroused the widest interest.

This is not to say that the foundations of classical genetics constructed in the course of the last 50 years have been undermined or destroyed. It is only that some of the more naive and simplistic concepts, essential in their own time, have now outlived their usefulness and are being replaced by more mature viewpoints. Hence, the significant studies of the day are aimed less at increasing precision of formulation of the principles of hereditary transmission, but rather are directed towards the building, on the basis of the facts observed from the advance positions of Mendelian and Neo-Darwinian theory, of a more comprehensive one.

Extension of knowledge carries in its wake specialization, the development of separate vocabularies, of esoteric techniques, and a bewildering range of special problems and concepts. The result is that, whereas genetics as a whole has an integrating influence over the various aspects of biology, the gaps between the different branches of genetics are becoming wider. The

International Congresses are designed to bring together the practitioners of the science, who between meetings dwell in isolated compartments, and to provide them with an occasion to learn what goes on in the other cells. The arrangement of the plenary sessions was a successful attempt to fulfill this function. Similarly the wide participation of evolutionists, of microbiologists, of clinicians, to mention some of the groups displaying their wares at Bellagio, contributed to the same end. On the other hand, the rather limited attendance of certain categories of workers (e.g., those in the applied animal field) was a regrettable symptom of overdiversification of interests.

On the business side of the Congress, the Permanent International Committee was reconstituted as a section of the International Union of Biological Societies. Of the 17 seats on the Committee, representing different geographical areas, 14 were filled, and 3 left vacant (China, Eastern Europe, including Czechoslovakia, Hungary, Poland, Rumania, and the U.S.S.R.), in the absence of representation at the Congress. Professor Claudio Barigozzi of Milan assumed the chairmanship of the Committee.

McGill University, Montreal, Canada, was chosen as the site of the next Congress, to be held probably in 1958. A resolution passed without dissent at the closing plenary session has an obvious bearing on this choice, and should be quoted here in full: "The Congress asks the International Committee not to recommend that the next Congress be held in any country to which it may be expected that scientists would be refused permission to enter on grounds of race, nationality, religion, place of birth or political associations, past or present."

To turn to the less serious aspects of the Congress, it may be noted that the location selected was indeed a fortunate one. The facilities of four resorts (Bellagio, Menaggio, Tremezzo, Cadenabbia), scattered on opposite shores of Lake Como around the promontory dividing it, were utilized. The weather was perfect, the entertainment lavish. A full day's trip to Lake Lugano, a banquet, a reception, a ball, a fête, visits to the notable gardens and villas of the area, tours of the countryside, trips to the city of Como and some of the surrounding mountains, provided but too many temptations to enjoy oneself, both for the geneticists participating in the meetings and for their families. It is hardly to be expected that organizers of future Congresses can match the standard of hospitality set by our Italian colleagues. To all of them, the guests owe a debt of gratitude for a memorable ten days.



News and Notes

New Techniques Highlight Calorimetry Conference

EXTREME high temperatures, miniature bomb calorimeters, thermistors, and liquid helium studies were described in the wide range of papers presented at the Eighth Annual Calorimetry Conference, which was held at the Institute for the Study of Metals, University of Chicago, on September 11-12. The program, which included individual and committee reports and a round-table discussion, was arranged by E. J. Prosen, National Bureau of Standards. Approximately one hundred scientists attended the sessions, at which Guy Waddington, Bureau of Mines, Bartlesville, was the presiding officer.

In the introductory remarks by J. W. Stout, University of Chicago, the various calorimetric programs at the University were outlined. These investigations include heats of solution and dilution of salts, strain energies in metals, and properties of materials below 1° K.

The design and performance characteristics of small bead-type thermistor thermometers were discussed by E. V. Larson, Brown Instrument Company. The extremely small size (less than 0.1 in. in diameter), rapid response, and high sensitivity make these instruments extremely useful. Recent developments in manufacture have produced thermistors that are stable and are ten times more sensitive to temperature changes than are resistance thermometers.

A liquid helium calorimeter designed for the temperature range 1-5° K was described by W. S. Corak, Westinghouse Research Laboratories. Studies on the specific heats of well-annealed samples of Cu, Ag, and Au were presented. The electronic contributions to the specific heat, which are represented by a term linear in the absolute temperature, are in satisfactory agreement with previously reported data for Cu and Ag; the Debye temperatures agree with those calculated from elastic theory. David White, Ohio State University, described the helium calorimeter in use at Ohio State. The heat transfer in this apparatus is accomplished by helium gas flowing through a small capillary tube in good thermal contact with the block. Data were presented on the heat capacities of tantalum and niobium (columbium) from 1-25° K.

A miniature bomb calorimeter for the determination of heats of combustion of organic samples of 20-50 mg mass with a precision of better than 0.5% was reported by W. S. McEwan and C. Anderson, Naval Ordnance Test Station, Inyokern: A lightweight bomb, coaxial stirrer, and special sample holder are some of the unique design features. The apparatus is particularly useful for studies on the heats of combustion of explosive materials, where large samples may present serious hazards. C. E. Messer, Tufts College, described a bomb calorimeter designed to determine the heats of reaction of metals and metal hydrides

with water. Use of the bomb technique confines the usually vigorous reaction and prevents the escape of the evolved hydrogen, thus avoiding a serious correction for the heat lost by the escaping gas. The heats of hydrolysis of Li, LiH, Na, and NaH were reported and the heats of formation of the hydrides were calculated. L. G. Cook, Atomic Energy of Canada, Ltd., presented the design and operating characteristics of a vacuum jacketed bomb calorimeter for precision measurements of heats of combustion. Use of the vacuum jacket reduced the overall heat leakage to 0.000° deg/min/deg which is a factor of 6 smaller than that which is usually found in standard air-gap types. Calibrations with benzoic acid showed a maximum deviation of $\pm 0.015\%$. A high precision isothermal calorimeter useful for studying small thermal effects occurring over long periods of time was described by P. Gordon, University of Chicago. The apparatus, using an organic vapor thermostat and a differential thermopile, has a sensitivity of approximately 0.002 cal/hr and has been used to study the evolution of stored energy in deformed copper samples as the metal is annealed.

A high temperature drop calorimeter, operating under high vacuum with radiofrequency heating and an ice calorimeter, has been developed at Ohio State University to measure heat contents from 1000-3000° K. This apparatus was described by M. Hoch, who discussed the sources and magnitudes of the experimental errors involved. A precision of approximately 0.35% has been obtained.

Malcolm Dole, Northwestern University, described the construction and operation of a new type of adiabatic bimetallic jacket for calorimetric studies of high polymers. This jacket diminishes the possibility of "hot spots" during heating and thus allows a more even distribution of energy over the unit. The general problem of adiabatic shield control for high precision adiabatic calorimeters was discussed by G. Guthrie, Bureau of Mines, Bartlesville, and a round-table discussion of the problem ensued.

The report of the Committee for the Publication of Data was presented by the Chairman of the committee, E. F. Westrum, Jr., University of Michigan, and was discussed by the Conference. A resolution outlining the recommendations of the Committee for proper publication of thermal data was approved by the Conference. This resolution will be submitted to the editors of various scientific journals.

H. F. Stimson, National Bureau of Standards, discussed the present status of units of energy and temperature scales. He pointed out that the International Conference of Weights and Measures is preparing to adopt a thermodynamic scale of temperatures which will differ slightly from that presently in use. C. H. Shomate, Naval Ordnance Test Station, Inyokern, explained the advantages in correlating and smoothing high and low temperature heat content data by use of

a modification of the usual equations involving a power series in the absolute temperature. H. L. Finke, Bureau of Mines, Bartlesville, presented a comparison of the thermal data on the Calorimetry Conference standard sample of *n*-heptane obtained independently at the low temperature laboratories at the National Bureau of Standards and at Bartlesville. The results indicate that the agreement between the two laboratories is better than 0.2%, which is within the accuracies claimed by the two laboratories.

At a business meeting held after a group luncheon on Saturday afternoon, the following officers for the coming year were elected: E. J. Prosen, present Chairman Elect, succeeds Guy Waddington as Chairman for 1954. Warren De Sorbo, General Electric Company, was chosen Chairman Elect. The Board of Directors for the coming year will consist of the above officers together with J. W. Stout, E. F. Westrum, Jr., Guy Waddington, and D. R. Stull, Dow Chemical Company.

The Role of Proteins in Ion Transport Across Membranes

A symposium on The Role of Proteins in Ion Transport Across Membranes was held Oct. 2 and 3, at the College of Physicians and Surgeons, Columbia University, New York. This conference was organized to bring together a small group of leaders in physical chemistry and a small group of biologists active in the field, and to explore the possible fruitfulness of such contacts for further research. In order to maintain informality of discussion, the number of participants was limited to 50, and only 8 lectures were given during the 2-day meeting.

The problem of ion transport is of general biological importance and of special interest in various functions, such as renal excretion and the generation of bioelectric potentials of nerve and muscle. The availability of radioactive materials has opened up much new information concerning ion movements, but the underlying molecular mechanisms are still obscure. Since this is a field in which biology has advanced close to the molecular level, it can obviously profit by the intellectual cooperation of physical chemists with biologists.

After a welcoming address by Dean Willard C. Rappleye, the following lectures were presented: Ion Transport Across Biological Membranes (Hans H. Ussing); The Generation of Bioelectric Potentials (Irwin B. Wilson and David Nachmansohn); Statistical Theories of Diffusion and Membrane Permeability (Ransom Parlin and Henry Eyring); Application of Irreversible Thermodynamics to Biological Systems (John G. Kirkwood); Ion Transport Across Charged Membranes (George Scatchard); Experiments on Field-Induced Transports (Peter J. W. Debye); Electrochemical Studies with Model Membranes (Karl Sollner); Interaction of Plasma Mercaptalbumin with Mercuric Ion and Organic Mercurials (John T. Edsall). David Rittenberg, Louis P.

Hammett, I. I. Rabi, and Raymond L. Fuoss were the chairmen of the four sessions. There were several guests from Europe, among them Professors F. J. W. Roughton (Cambridge), Hans H. Weber (Tübingen), and G. Ehrensvärd (Stockholm). Every lecture was followed by lively discussions and both groups felt that the conference was a stimulating experience.

The meeting was made possible by a grant from the National Science Foundation. The lectures given at the conference and a few additional related papers, not included in the program, will be published by the Academic Press.

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The 1953 Nobel Prize Awards

Editor's Note: By now everyone is aware of the names of the new Nobel prize winners, but their full record of achievement and their personal histories are very likely known only to biochemists. The following accounts have been specially prepared for SCIENCE by persons who have worked with Krebs and Lipmann in their own laboratories and know them exceptionally well.

The award of a Nobel Prize to Hans Adolf Krebs is fitting recognition of his fundamental investigations in intermediary metabolism. He is primarily known for the elucidation of the ornithine cycle by which urea is synthesized, and for the demonstration of the tricarboxylic acid cycle. The latter is now recognized as a major pathway for the oxidation of carbon compounds in animal tissues. Both investigations are landmarks in the development of modern biochemistry.

Hans Adolf Krebs was born Aug. 25, 1900, at Hildesheim, Germany, the son of Georg Krebs, M.D., and Alma Davidson. In the usual European fashion, his university training was received at a number of institutions, including Göttingen, Freiburg, Munich, and Berlin. He received his M.D. degree from Hamburg in 1925. Even during the period of his medical training he found time for laboratory work, and it was natural, therefore, that after completing his degree he should become an assistant in Professor Warburg's Department at the Kaiser Wilhelm Institute for Biology at Berlin-Dahlem. During the following five years, Krebs worked on a variety of problems associated with the scientific interests of Warburg's group, and also began work on the deamination of amino acids which was to be completed later at Cambridge.

In 1932, he became Privat Dozent of Internal Medicine in Professor Thannhauser's Clinic at Freiburg. Here, in spite of the press of clinical duties, he continued with laboratory work and made his first major contribution to biochemical science in working out the cyclic process for urea synthesis in mammalian liver.

With the advent of the Nazis, Thannhauser was ousted from his clinic and Krebs was forced to leave Germany. At the invitation of Professor Sir Frederick

Gowland Hopkins, who greatly admired his work, he joined the Department of Biochemistry at Cambridge University, first as a Rockefeller Research Fellow, and later as University Demonstrator in Biochemistry. During this time, he continued to study the enzymic deamination of amino acids and was concerned with the general question of the mechanism of hydrogen transport in animal tissues. In 1935 he became Lecturer in Pharmacology at the University of Sheffield. His interest in the role of succinic and fumaric acids in cellular respiration led to the elegant series of experiments which resulted in the demonstration of the citric acid cycle. Although both the mechanisms for urea synthesis and for pyruvate oxidation involve cyclic processes, they do not appear to have emerged from any similar preconceived method of experimental attack. In the case of urea synthesis, Krebs' careful series of experiments were necessary to construct a system which was practically unknown; in the case of the citric acid cycle, his discovery, with W. A. Johnson, of a mechanism for the synthesis of citric acid from oxaloacetic acid and pyruvic acid supplied the missing step that permitted him to organize many previously known facts into a coherent pattern. In both cases, however, description of the qualitative nature of the processes that occurred was followed by experiments which demonstrated their quantitative importance in cellular activity.

During this same period he also continued work which he had started in Freiburg on the synthesis of purines in avian liver. In birds, the purine uric acid is the major nitrogenous excretory product, replacing the urea of mammals. Krebs showed that hypoxanthine was an intermediate in the formation of uric acid, and demonstrated a net synthesis of hypoxanthine from ammonium pyruvate in isolated slices of pigeon liver. This work, like experiments on the conversion of carbon dioxide and pyruvic acid to oxaloacetic acid in pigeon liver, was an important starting point for work in other laboratories, using isotopic tracer methods which were not available to Krebs until after the war.

During the war years which followed, Krebs supervised research for the British Medical Research Council on the human nutritional requirements for vitamin A and ascorbic acid. As a result of these studies, the official recommended requirement for dietary ascorbic acid was reduced from 70 mg per day to 30 mg.

Since 1945 Krebs has investigated the oxidation of acetate by yeast, and concluded that in this organism the tricarboxylic acid cycle is not a major pathway for the oxidation of acetate. He has also described a number of analytical techniques, including those for the manometric estimation of glutamic and aspartic acids and their amides by the use of specific enzymes. In this period came experiments on the accumulation of glutamic acid by isolated tissue slices, together with measurement of the accumulation and exchange of potassium ions in the same system. The results bear directly on the important question of the relation between ion transport and metabolic reactions, especially with respect to the central nervous system.

The Rockefeller Foundation has continuously supported Krebs' research since the early days in Sheffield. In 1945 the British Medical Research Council established the Unit for Research in Cell Metabolism at Sheffield University under his direction, and at this time he was made Professor of Biochemistry in the University, and new quarters were made available for his department. Soon afterwards, in 1947, he was elected a Fellow of the Royal Society. Shortly after the announcement of his Nobel Prize in Medicine, he received a Lasker Award from the U.S. Public Health Association for his "outstanding contributions to medical research and public health."

In 1938, Krebs married Margaret Cicely Fieldhouse, of Wickersley, Yorkshire. They now have two sons and a daughter. Like many of their neighbors in Yorkshire industrial towns, Krebs and his family spend many happy hours on the moors and hills of the surrounding countryside.

Although Krebs is most prominently known for his fundamental investigations, he shows keen interest in the more practical aspects of biochemistry, and especially in its applications to clinical medicine. He takes an active part in the teaching of biochemistry to the medical students at Sheffield. Besides carrying out his own research, Krebs now devotes a considerable portion of his time to the dozen or more investigators in his own laboratory. Papers emanating from the various research groups in his laboratory cover a wide variety of topics, including the secretion of acid by the stomach, the synthesis and secretion of amylase by isolated slices of pigeon liver, and the transferring action of carbohydrate-splitting enzymes. The atmosphere of the Sheffield laboratory is one of unusual harmony as well as intellectual stimulation. This is due in no small measure to Krebs' personal and intellectual qualities, and to his cordial interest in the scientific and other problems of his colleagues. His ability to plan the exact necessary experiment, his grasp of all pertinent factors in an experimental situation, his efficient utilization of his time and facilities, and his ability to synthesize data into a coherent pattern, are the admiration of his colleagues and students.

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The biochemical career of Fritz Lipmann, a cowinner with Hans Krebs of the 1953 Nobel Prize in Medicine and Physiology, has been one in which outstanding experimental ability has been combined with an unusual creative capacity. His contributions are certainly indicative of these attributes.

Lipmann began his biochemical studies with Rona in Berlin. It was here that his interest in intermediate metabolism developed and prompted him to join Otto Meyerhof's laboratory at the Kaiser Wilhelm Institute. Meyerhof indoctrinated him into the problem of the energetics of living systems. Lipmann's contributions to these problems have been of the greatest sig-

nificance, and there is no question that many of his concepts have been instrumental in the present rapid development of biochemistry. At the Kaiser Wilhelm Institute, Lipmann also was able to gain a great deal of laboratory "know how," particularly from Karl Lohmann.

After leaving Meyerhof's laboratory in 1931, he spent a year at the Rockefeller Institute with Phoebus Levene. The work on serine phosphate, carried out at the Rockefeller Institute, can now be considered as a pioneer endeavor into the present blossoming field of phosphoproteins.

Sensing an unhealthy atmosphere in the rising power of Hitler, Lipmann decided his future was best elsewhere, and did not return to Germany. He took a position at the Carlsberg Laboratories in Copenhagen in 1932. Here he worked on the Pasteur effect and the glucose-6-phosphate oxidative pathway. It was in Denmark that Lipmann began the investigations which eventually led to the discovery of coenzyme A and its significance in metabolic reactions.

Lipmann became interested in the role of thiamine and its relationship to pyruvate oxidation. He initiated a study of *Lactobacillus delbrückii* because of the apparent solubility of the pyruvate oxidase system in this organism. His investigations eventually led to the isolation of acetyl phosphate as a product of pyruvate degradation. However, the actual accomplishment of this isolation proceeded with great difficulty, not only because of the nature of the problem, but because of his move to the United States in 1939.

Lipmann's first position in the United States was at Cornell University Medical School. In 1941 he took over a small laboratory at the Massachusetts General Hospital, where he completed his work on acetyl phosphate. His outstanding ability was soon recognized by the staff of Massachusetts General Hospital, and they encouraged his work by continuing to increase his facilities and support. At present he is Head of the Biochemical Research Laboratory, which is located in the new research building of the hospital, and in which at present a number of postdoctoral and predoctoral fellows are receiving training. He is also Professor of Biochemistry at the Harvard Medical School, an appointment which he received in 1949.

At the Massachusetts General Hospital, Lipmann began a study of the mechanism of acetylation of aromatic amines. He started this investigation because he believed that acetyl phosphate might act as an acetyl donor in this reaction, and that this might lead also to a better understanding of the general problems of fat metabolism and protein synthesis.

It was in this work on acetylations that coenzyme A was discovered and eventually shown to contain pantothenic acid. The early studies of Lipmann and his coworkers on the coenzyme indicated its great significance, and as a result, many of the problems in carbohydrate and fat metabolism have now been solved. Present experiments also suggest that coenzyme A plays a role in sterol and protein synthesis, and it is likely that in the next few years, these prob-

lems will be elucidated because of the present knowledge of coenzyme A function.

Lipmann's paper in 1941 on the "Metabolic Generation and Utilization of Phosphate Bond Energy" has unquestionably had a decided influence on biochemical thinking. The concept of the energy-rich phosphate bond was clearly stressed in this paper, and it was this paper which focused attention on the importance of the phosphate bond in promoting biosynthetic reactions. At present Lipmann is carrying out work on the thyroid hormone as a regulator of phosphate bond generation. This is a field which has long intrigued him.

It is a tribute to Fritz Lipmann that he was able to carry out his work under what were sometimes the most unfavorable conditions. His contributions and creativeness are self evident of his remarkable scientific ability, while those of us who have been associated with him intimately know him not only as a distinguished scientist, but a warm, considerate person whose greatness is beyond his scientific attributes.

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Science News

The first positive identification of some tissues in which antibodies actually are formed is described in a paper, entitled "The Formation of Tetanus Antitoxin by Spleen and Lymph Node Intraocular Transplants," that appeared in the September issue of the *Yale Journal of Biology and Medicine*. Written by William M. Hale, now professor of bacteriology at the University of Tennessee Medical School, and Richard D. Stoner of the bacteriology division of the Medical Department, Brookhaven National Laboratory, the article describes experiments conducted at Brookhaven, under sponsorship of the U.S. Atomic Energy Commission.

Drs. Hale and Stoner used cobalt 60 gamma radiation, together with implantation of tissues into the eyes of irradiated mice, to find out where antibodies are formed. They now report the first direct evidence that the spleen and lymph nodes produce antibodies to tetanus toxoid.

The two bacteriologists immunized a group of mice with the antigen, tetanus toxoid. The irradiated animals had been exposed to amounts of gamma radiation known from previous experiments to be sublethal, yet sufficient to destroy the animals' ability to produce antibodies. Since the radiation prevented antibody formation in the recipient animals, any antibody now formed would presumably come from the transplanted tissues growing in the anterior chamber of the host's eyes.

Spleen and lymph node transplants produced significant amounts of antibody under these conditions. In addition, intravenous injection of the recipient animals with tetanus toxoid greatly increased

antibody formation by the tissues in the eyes of irradiated mice. Tissues other than spleen and lymph nodes are now being tested to determine whether these, also, may be sites of actual antibody production. Bone marrow, liver, lungs, blood, central nervous system, and other sites have been mentioned as possibilities by various investigators.

Current experiments also will evaluate antibody formation resulting from use of different methods of introducing antigens into donor animals: under the skin, through the peritoneum, or, as in the experiments reported in the *Yale Journal*, into the blood stream. In Hale's and Stoner's experiments to date both donor and recipient animals have been from a single inbred strain of mice.

A report by R. G. Bunge and J. K. Sherman (*Nature*, Oct. 24, 1953) tells of the successful **impregnation** of three women at the State University of Iowa Medical School with spermatozoa that had been pretreated with 10% glycerol and then frozen with "dry ice." Of spermatozoa so treated, 67% survive after thawing. The three recipients were respectively nulliparous, primiparous, and nulliparous, and in August had missed six, five, and three menses respectively, and had positive Ascheim-Zondek tests and other signs of well-advanced pregnancy. The three women's personal histories "indicate a high degree of integrity and the source of the conceptions is valid."

Samuel N. Kramer, a cuneiformist at the University Museum, University of Pennsylvania, and Martin Levey, a chemist of Pennsylvania State College, have translated the **oldest known medical "handbook,"** a 4000-year-old Sumerian clay tablet. The tablet lists an anonymous doctor's prescriptions for salves, filtrates, and internal remedies, and is notable for the absence of any taint of sorcery or mysticism.

Scientists in the News

The Board of Directors of the AAAS, at its meeting on Oct. 18, voted unanimously to invite **Carlos E. Nabuco de Araujo, Jr.**, of Químico Analista e Industrial, Rio de Janeiro, to serve as the official representative of the Association at the meeting of the Latin American Association for the Advancement of Science in Parana, Brazil.

Roy Elwood Clausen, Professor of Genetics and Chairman of that department, has been named Faculty Research Lecturer on the Berkeley campus of the University of California for the academic year 1953-54. Dr. Clausen was selected because of his outstanding career in genetics "as both teacher and investigator." He is widely known for his research on the heredity of Nicotiana, the tobacco plant, with emphasis on the transference of disease-resistant traits from one species to another.

The Board of Trustees of *Biological Abstracts* announces that **G. Miles Conrad** has been appointed Di-

rector of *Biological Abstracts*, a new post designed to integrate more completely the abstracting, indexing, business management, and special services of the organization. Most recently he has been concerned with document reproduction, information retrieval, and surveys of user reaction as head of Documentation Research, Technical Information Division, Library of Congress. His past experience includes field and laboratory research in ichthyology and mammalogy with the American Museum of Natural History and writing and editing in the fields of biology, chemistry, and engineering for a number of scientific and technical magazines.

At the Fall Members' Meeting in October, the Brooklyn Botanic Garden awarded its Distinguished Service Medal to **Benjamin Minge Duggar** for his discovery of aureomycin.

Similarly honored were **Mr. and Mrs. Walter D. Brownell**, for the development of 56 varieties of subzero, disease-resistant roses; and **Mrs. Dean Clay Osborne**, for the establishment at the Botanic Garden of the Osborne Memorial Horticultural Section.

Ludwik Gross, Chief of Research at the Veterans Administration Hospital, Bronx, N.Y., has received the Robert Roesler de Villiers Award for his contributions to the knowledge of the nature and cause of leukemia. The paper which earned the award for Dr. Gross was one of 226 papers from 22 countries which were submitted to the Foundation for its Contest II; in the first contest only 30 papers from 8 countries were considered.

Recently **Gilbert H. Grosvenor**, President of the National Geographic Society, received from Robert A. Anderson, Secretary of the Navy, the Navy's highest civilian citation, the Distinguished Public Service Award. The award was made in recognition of Dr. Grosvenor's direction and planning of expeditions and research jointly conducted by the Society and the Navy.

Louis G. Herrmann, Associate Professor of Surgery at the University of Cincinnati Medical College, has been made an honorary fellow of the Academy of Surgery of France.

The annual James Greenwood Lecture in Neurosurgery at the University of Texas Medical Branch was given on Nov. 16 by **Sir Geoffrey Jefferson**, Professor of Neurosurgery at the University of Manchester and President of the Manchester Literary and Philosophical Society. The subject of Sir Geoffrey's lecture was "The Anatomy of the Trigeminal Nerve and Its Clinical Significance." He also gave a special seminar on the opportunities of the search for the anatomical site of the soul.

Elvin C. Stakman, Emeritus Professor of Plant Pathology at the University of Minnesota and Past President of the AAAS, was unanimously re-elected as the Association's representative on the National Com-

mittee for UNESCO by action of the Board of Directors on Oct. 18, 1953.

Two A. Walter Suiter Lectures on mental health were presented at the New York Academy of Medicine on Nov. 5. **John C. Whitehorn**, Henry Phipps Professor of Psychiatry, The Johns Hopkins University School of Medicine, spoke on "The Acquiring and Imparting of Mental Health," and **Frederick C. Redlich**, Professor and Chairman of the Department of Psychiatry, Yale University School of Medicine, spoke on "The Influence of Environment on Mental Health."

Education

A unique electrical engineering laboratory has been donated to **Carnegie Institute of Technology** by Westinghouse Electric Corporation. Valued at approximately \$100,000, the new installation is expected to stimulate student interest in power engineering, which has been somewhat overshadowed by the swift rise of developments in the communications field.

The laboratory will be used for education and research dealing with the detailed and advanced study of electrical power systems and advanced study of alternating current generators. The new facilities will provide for advanced instruction in rotating machinery for senior undergraduate students and work in power system stability for graduate students. The laboratory will be under the direction of **Dr. E. M. Williams**, Head of the Electrical Engineering Department at Carnegie Tech and will be supervised by **Dr. H. M. McConnell**, Assistant Professor of Electrical Engineering.

Modern scientific development and what it means for mankind will be considered in the **First Annual Symposium on Recent Advances in Science: Physics and Applied Mathematics** to be sponsored during the spring semester by New York University's Division of General Education. Scientists, engineers, mathematicians, and technicians will gather at NYU's Washington Square Center for the 15-week course to be conducted from 7 to 9:30 P.M., on Mondays, Feb. 8 to May 24. Designed for technically qualified persons who wish better to understand and appreciate contemporary scientific developments, the symposium presents a leading man of science each week in a session which also allows ample time for discussion.

The Council of The New York Academy of Medicine at its last meeting endorsed the Bicentennial Celebration of Columbia University, and voted to cooperate in the elaboration of the theme of the celebration, "Man's Right to Knowledge and the Free Use Thereof." In this direction the Committee on Medical Information of the Academy is dedicating its current series of **Lectures to the Laity**, dealing with the reciprocal relations between medicine and the other disciplines, to the bicentennial. The schedule for the final 3 lectures is as follows:

Jan. 6, "The Bearing of Anthropology upon Medi-

cine." **Benjamin D. Paul**, Social Anthropology, Sch. of Pub. Health, Harvard University.

Jan. 27, "Where Law and Medicine Meet." **David W. Peck**, Presiding Justice, Appellate Div., N.Y. Supreme Court.

Feb. 3, "Medicine and Art." **A. Hyatt Mayor**, Curator of Prints, The Metropolitan Museum of Art.

With the support of the Foreign Operations Administration, 150 young scientists belonging to the Organization for European Economic Cooperation (OEEC) will be brought to the United States to spend up to two years participating in research in American universities. A committee of the National Academy of Sciences, which met in October for the purpose of organization, will manage the program.

The plan stipulates that the visiting scientists are to have earned their doctorates in the natural sciences or engineering or to have had equivalent training so that they are ready to begin research as soon as they arrive in this country. Each one must also agree to return home after the two years of residence here. While in this country, the scientists will be paid a per diem subsistence and, in addition, funds will be provided for one trip a year to society meetings in their respective fields.

The academies of science and their related organizations in the foreign countries involved will make the preliminary nominations and send here a screened list of candidates, but the final choice will rest with the National Academy of Sciences committee.

The Department of Bacteriology and Preventive Medicine of the **University of Missouri** has become the Department of Microbiology. This change is in line with the expansion of the School of Medicine's 2-year basic science medical curriculum to the complete 4-year program.

Grants, Fellowships, and Awards

Nominations are solicited for the 1953 **Borden Award in Nutrition** consisting of \$1000 and a gold medal made available by the Borden Company Foundation, Inc. The American Institute of Nutrition will administer the award, which will be conferred in recognition of distinctive U.S. or Canadian research that has emphasized the nutritive significance of the components of milk or of dairy products. The award will be made primarily for the publication of specific papers, but the judges may recommend that it be given for important contributions over an extended period of time. It may be divided between two or more investigators. The formal presentation will take place at the annual meeting of the Institute in the spring of 1954. Nominations should be accompanied by data relative to the nominee and his research, and they must be in the hands of the Chairman of the Nominating Committee by Jan. 1, 1954. The Chairman is **J. B. Brown**, Institute of Nutrition & Food Technology, Ohio State University, Columbus 10.

The Fund for the Advancement of Education is again

offering approximately 250 Faculty Fellowships for the academic year 1954-55 to college teachers throughout the United States. The purpose of this program is to enable promising teachers to broaden their qualifications for teaching in their respective fields as part of a program of liberal education. Efforts will be made to seek out those teachers who are judged to have the greatest possibility for growth and development, rather than those who have already achieved recognized prominence in their fields. The Fund expects, as a result of these fellowships, to strengthen college teaching in the United States.

In the past three years, the Fund has granted similar fellowships to 750 college teachers from all states of the Union. Each fellowship provides a grant approximately equivalent to the salary of the recipient plus certain expenses. Candidates should be men and women between the ages of 30 and 45 who have been teaching steadily for several years, and each must be nominated by his institution. An institution of less than 600 undergraduates may nominate two candidates; institutions of 600 to 1500 undergraduates may nominate three; and institutions with more than 1500 may nominate four candidates. In each case, the institution nominating the candidates agrees to continue the recipient in his teaching career in 1955-56, and if possible, replaces him during his year as a fellow.

Fellowships are available in the humanities, the social sciences, and the natural sciences, but not in the technical or professional subjects, and the Committee on Faculty Fellowships, which administers this program, will consider any proposal which aims at broadening and improving the candidate's capacity to make his work a more vital part of liberal education. These fellowships are not intended to provide for the completion of doctorate study as such, or to support private and individual research projects, except as they bear directly upon, or are subordinate to, the effort to improve the candidate's teaching. Preference will be given to those candidates who, in addition to showing promise as outstanding teachers and scholars, are judged to possess the character and personality to become centers of influence on their campuses.

Application forms and full information concerning this program will be in the hands of the presidents of all colleges and universities in the United States within the next few days. *Applications must be submitted by Jan. 31, 1954*, and announcement of the awards will be made on or about April 8, 1954. Application forms and further information may also be obtained from The Committee on Faculty Fellowships, The Fund for the Advancement of Education, 575 Madison Ave., N.Y. 22, N.Y.

Under a program devised jointly by McGill University and the Arctic Institute of North America and supported financially by the Carnegie Corporation of New York, certain scholarships are offered to students possessing a bachelor's or master's degree or equivalent. These scholarships are tenable at McGill

University, Montreal, and are normally offered to students proceeding to a doctoral degree in a subject calling for active field research in Arctic or Subarctic North America. Candidates who do not intend to proceed to a degree are not necessarily disqualified. Such subjects as anthropology, bacteriology, botany, geography (including glaciology and meteorology), geology, genetics, parasitology, psychiatry, psychology, sociology, and zoology will be considered, and successful candidates will be enrolled in one of these departments.

The scholarships are normally tenable for one year and are of average value of \$1000 for the academic session, and \$1250 for the expenses of a summer's field expedition. Applications should be submitted to the secretary of the Carnegie Arctic Program, Arctic Institute of North America, 3485 University Street, Montreal, P.Q., and should include a confidential recommendation of the candidate's qualifications in his or her selected field, and a clear statement of the intended arctic or subarctic research project. *Applications for session 1954-55 should reach Montreal by April 1, 1954. If field work in the summer of 1954 is anticipated, applications must be in by Jan. 1, 1954.* In arriving at decisions the committee will bear in mind the general furtherance of northern research and will pay particular attention to the demonstrated interest in the north and the physical suitability of candidates as well as to their academic qualifications.

The National Science Foundation will award individual grants to defray partial travel expenses of a limited number of American scientists who will attend the following meetings:

The 3rd Congress of the International Association of Gerontology, to be held in London, England, July 19-23, 1954.

The 8th Congress of the International Society for Cell Biology, to be held in Leiden, Netherlands, Sept. 2-9, 1954. Application blanks for grants may be obtained from the National Science Foundation, Washington 25, D.C. *Completed applications must be returned to the Foundation by Feb. 15, 1954*, and announcement of the awards will be made in March.

Nominations are invited for the 1953 Osborne and Mendel Award of \$1000 established by the Nutrition Foundation, Inc. for the recognition of outstanding accomplishments in the general field of exploratory research in the science of nutrition. The award will be given to the investigator who has made the most significant published contribution in the year preceding the annual meeting of the Institute, or who has published a series of contemporary papers of outstanding significance.

The recipient will be chosen by a Jury of Award of American Institute of Nutrition. As a general policy, the award will be made to one person; however, to prevent an injustice it may be shared by several persons. Preference will be given to research workers in the United States and Canada, but investigators in other countries, especially those sojourning in the

United States or Canada for a period of time, are not excluded from consideration. Membership in the Institute of Nutrition is not a requirement for eligibility, and there is no age limitation. Nominations may be made by anyone. Accompanied by data relative to the accomplishments of the nominee, they should be sent before Jan. 1, 1954, to the Chairman of the Nominating Committee, H. E. Robinson, Research Laboratories, Swift and Co., Union Stock Yard, Chicago 9, Ill.

The Population Council, Inc., has organized a fellowship program in the study of population to assist in the advanced training of students in the social and natural sciences at the predoctoral or postdoctoral levels. The Council is planning to grant approximately six fellowships (for study in the United States and elsewhere) during the academic year 1954-55, to be divided between students from the United States and from other countries. Fellows will normally receive support for full-time work for a period of about one year. The basic stipend at the rate of \$2500 per year may be supplemented to provide for maintenance of dependents and, especially in the case of foreign students, for travel or exceptional expenses. It may be diminished because of lesser need or partial support from other sources. Somewhat larger stipends may be granted to postdoctoral than to predoctoral fellows. Preference will be given to candidates who are not over forty years of age.

For information or application forms relating to this program, inquiries should be addressed to Mr. Frederick Osborn, Executive Vice-President of The Council, 230 Park Avenue, New York 17, N.Y. Applications for fellowships for the academic year 1954-55 should be received before Feb. 1, 1954.

The School of Civil Engineering of Cornell University has announced the establishment of a 2-year fellowship for graduate study in the use of bituminous materials and aggregates for bituminous paving mixtures. This fellowship has been made possible by the generosity of the New York State Bituminous Concrete Producers Association. Applicants for the spring term, 1954, are now being considered. Information about the fellowship may be obtained from Prof. Taylor D. Lewis, Lincoln Hall, Cornell University.

In recognition of the contributions to science of Selman A. Waksman, a postdoctoral fellowship, the Waksman-Merck Postdoctoral Fellowship in the Natural Sciences, has been established at Rutgers University by Merck and Co., Rahway, N.J. The Fellowship is open to citizens of the United States or Canada who have received or are about to receive the Ph.D. or equivalent degree and are interested in further training and research experience in biochemistry, chemistry, entomology, microbiology, nutrition, physics, physiology, or zoology as related to medicine and health.

The award is \$4000 for one calendar year, beginning July 1, 1954. The closing date for receipt of

applications is Dec. 21, 1953. The award will be made about Feb. 10, 1954. Application forms may be obtained from: Dean of the Graduate School, Rutgers University, The State University of New Jersey, New Brunswick, N.J.

In the Laboratories

The Atomic Energy Commission has announced that construction of the projected Spoon River explosives processing and assembly plant near Macomb, Ill., has been cancelled. This action was taken following technical developments which will considerably enlarge the output of already existing plants turning out the same products that would have come from the projected new plant. The future requirements of the atomic energy program in this line can be supplied, it has been established, by the present plants; hence construction and operating expenses for the planned Spoon River Plant may be saved. The net saving in construction and engineering costs is some \$26,000,000. In addition, about \$4,000,000 in start-up cost and \$3,000,000 net a year in recurring operating costs will be saved. In announcing cancellation of the project, the Commission expressed its gratitude for the cooperation of all concerned, and especially of the contractors and communities in the area, and its regret for the inconvenience caused by the termination.

Cornell Aeronautical Laboratory, Inc., has announced that its large 2000 horsepower propeller dynamometer has returned to operation. Built and operated by Cornell Laboratory for the Air Force, the dynamometer has been inactive for several months due to a gear breakdown.

Meetings and Elections

By unanimous action of the Board of Directors of the AAAS at the meeting on Oct. 18, 1953, the following members were honored by election to Emeritus Life Membership: F. R. Watson, Walter Fred Hunt, Eugene Lindsay Opie, Charles H. Briggs, Paul Franklin Clark, and Harold Albert Wilson. Those elected to Emeritus Annual Membership were: Joseph A. Capps, Harrison Randall Hunt, Walter P. Taylor, and Roger C. Smith.

The American Society for Engineering Education has elected the following officers for 1953-54: pres., L. E. Grinter, University of Florida; treas., G. W. Farnham, Ronald Press Company; sec., A. B. Bronwell, Northwestern University; asst. sec., C. W. Watson, Northwestern University. The vice presidents are: B. R. Teare, Jr., Carnegie Institute of Technology; W. C. White, Northeastern University; W. L. Everitt, University of Illinois; and E. A. Walker, Pennsylvania State College.

The 5th Annual Meeting of the Brazilian Association for the Advancement of Science was held at Curitiba, State of Paraná, from Nov. 11 to 18, and included the following sections: Zoology, animal physiology,

pharmacology, pathology, botany, genetics, geology, chemistry and physics. Symposia were organized on electron microscopy applied to biology, chemical structure and biological activity, modern algebra, microanalysis of organic compounds, physical methods applied to biology, and statistical methods for industrial technology. Some of the symposia were specially concerned with problems of industrial development.

The 4th Annual Research Conference on Plant Physiology was held at London, Ont., Nov. 2-3, 1953, with the University of Western Ontario and the Science Service Laboratory of the Department of Agriculture acting as joint hosts. These annual conferences are organized with the financial assistance of the National Research Council of Canada. Fifty-five scientists attended. They represented 12 universities and 14 government laboratories from five provinces. Nineteen papers were contributed from 16 laboratories on such varied topics as water relations in trees, plant nutrition, experimental morphology, enzymatic reactions, stomatal movement, and vernalization and flowering. An entire session was devoted to the presentation of 6 papers on various aspects of the metabolism of C^{14} -labelled compounds in both healthy and diseased plants.

Two invited speakers gave a comprehensive review of their fields of interest. C. S. Hanes, Department of Biochemistry, University of Toronto, spoke on the formation of peptides in enzymic reactions. He discussed various types of condensing reactions that have been isolated from plant and animal sources and explained how these bring about the coupling of amino acids into short chains by the formation of peptide or peptide-like linkages. Reactions of this type, he suggested, may be involved in the biosynthesis of protein. S. Aronoff, Institute of Atomic Research and Department of Botany, Iowa State College, spoke on the metabolism of soybean leaves. He described the effects of detachment and other treatments on processes such as photosynthesis, protein synthesis, and translocation, and discussed the results of these experiments from the standpoint of the specific functions of leaves and the biochemical interdependence between them and other plant "organs."

A High-speed Computer Conference will be held on the campus of the Louisiana State University, Jan. 28-30. This is the first time that a conference of this kind has been held in the South. It will draw its attendance from persons in business, research, engineering, and related professions from all over the nation. The conference is being sponsored by the university in cooperation with a number of business, accounting, research, and engineering organizations interested in high-speed computers.

The purpose of the meeting is to discuss the uses and applications of high-speed computers in business office procedures, statistical operations, and scientific and technical analyses. Electronic and other high-speed computing devices and equipment will be on

exhibit during the meeting. Early registration will be appreciated; a registration fee will be charged. Those desiring more detailed information should write directly to Mr. Leon Megginson, Louisiana State University, Baton Rouge.

The 3rd National Symposium of the Division of Organic Chemistry, Chemical Institute of Canada, will be held at McGill University, Mar. 8-9, 1954. G. E. McCasland of the University of Toronto is Division Chairman.

Heading the speakers' list will be Nelson Leonard of the University of Illinois, who is secretary of the Organic Division of the American Chemical Society, and Raymond Lemieux of Saskatchewan. Dr. Lemieux will be awarded a special citation in honor of his recent achievement in synthesizing sucrose. The full symposium program will be announced at an early date.

Accommodations will be available at the Sheraton-Mount Royal Hotel (official hotel). Hotel reservation requests should be sent well in advance to the division secretary, Alfreds Taurins of McGill University, who will gladly furnish further information on matters of housing, registration, or transportation.

This will be the third biennial symposium of the Organic Division, C.I.C. Symposium papers, presented by invitation, usually review recent progress in certain relatively broad fields of organic chemistry, thus differing from the short research papers given at the C.I.C. annual June conference.

The 4th annual Rochester conference on high energy nuclear physics will be held at the University of Rochester, Jan. 25-27. Participants in the conference, sponsored by the University of Rochester, the National Science Foundation, and a group of Rochester industries, will include leading research workers in the high energy physics laboratories of the United States, Canada, Mexico, England, and Europe. The conference will be under the direction of Joseph B. Platt, Acting Chairman of the university's Physics Department. The director of the previous Rochester conferences, Robert E. Marshak, is this year Visiting Professor of Physics at the Sorbonne, France, on leave of absence from Rochester.

The purpose of the conference is to bring together a representative group of active workers in the field of high-energy physics for an informal discussion of the latest experimental results and their interpretation. Among the topics scheduled to be considered are nucleon scattering, nucleonic production of mesons, multiple meson production, new unstable particles, and photo-meson production. A complete record of the conference proceedings will be made available to high energy physics laboratories throughout the world within a month after the meeting.

More than 100 scientists, including four Nobel prize winners, representing 46 research institutions, 17 states, and 9 foreign countries, attended the last Rochester high energy physics conference held in December, 1952.

Technical Papers

One-Step Preparation of C^{14} -Cyanide from Barium Carbonate- C^{14}

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The importance of cyanide in the synthesis of organic compounds labeled with isotopic carbon requires that it be made available in high yields by simple and inexpensive procedures starting with barium carbonate. Methods (1-5) have been described for the conversion of alkali carbonates to cyanide but each has its own limitation. A procedure has been developed in this laboratory based on the findings of Hood and Salamon (6) and J. A. McCarter (7) whereby barium carbonate can be converted to sodium cyanide in one step. This was accomplished by heating barium carbonate, zinc dust, and metallic sodium in a stream of anhydrous ammonia which had passed over hot iron. Iron seemed to have an important role in that it catalyzed the decomposition of ammonia to give nitrogen gas and other "active" forms of nitrogen which were essential in the reaction. The yields in this laboratory were quantitative as described in the following experimental procedure.

Powdered anhydrous C^{14} barium carbonate (1.0 millimole) was mixed with 1.0 g of zinc dust and 0.2000 g of metallic sodium in pea size chunks, and this mixture was transferred to a porcelain combustion boat of suitable size. The boat was placed in a Vycor combustion tube (600 mm in length and 19 mm inside diameter) in an atmosphere of anhydrous ammonia and containing a 5.0-g ball of iron wire or 5.0 g of powdered iron distributed throughout a plug of Pyrex glass wool occupying the mid-portion of the tube. The boat was pushed into the tube until it touched, or almost touched, the iron plug.

The end of the tube nearest the iron was connected to a cylinder of anhydrous ammonia. A stream of ammonia was allowed to flow through a gas bubbler at the rate of 3 bubbles/second in and through the tube containing the mixture. The portion of the tube containing the mixture and iron was brought to and maintained at approximately 650°C for a period of 4 hr. The flow of ammonia was continued until the tube was cool.

The boat and all contents of the tube, except the iron ball, were washed into a 250-ml flask attached to a Kjeldahl distillation head for subsequent distillation of hydrogen cyanide. The solution in the flask was acidified with dilute (2 N) sulfuric acid and 20-30 ml of distillate were collected in an Erlenmeyer flask containing a 20% excess of the theoretical amount of 1 N sodium or potassium hydroxide.

Analysis by the argentimetric method (8) of the distillate obtained in three experiments showed a yield

of cyanide which was quantitative. The specific activity of the labeled cyanide was unchanged from that of the barium carbonate used as the starting material.

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Evaluation of Oral Temperature Readings

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Many studies have dealt with the variability of body temperature as reflected in inter-individual differences, day-to-day changes, diurnal variations, and other comparisons (1). Such studies, while yielding considerable information as to the extent of variability to be expected under different conditions, have failed to provide any systematic method for evaluating the significance of a given temperature reading, or a difference between two readings taken under specified circumstances. One possible solution to this problem is presented in the following paragraphs; it involves an approach which has been used in connection with a similar question regarding metabolism measurements (2).

The data for this analysis were taken from 29 ostensibly normal male university students, ranging in age from 17 to 27 years. Twelve readings of oral temperature were made upon each subject, the complete series consisting of records taken at 8:00 A.M. (before breakfast), 12:00 M., 6:00 P.M., and 10:00 P.M. on each of 3 different days, approximately a week apart. Only 1 subject was observed on any given day. Every session was preceded by a 30-min rest, the subject lying upon a cot throughout this period and during the actual observation of his temperature. All readings were made with the same thermometer, a MICH 3 Oral (Serial J 1273).¹ The thermometer always was inserted under the subject's tongue and left in place a full 3 min.

The 348 temperature readings thus obtained ranged from 95.4° to 99.1° , and averaged 98.0°F , a value very close to Ivy's mean of 98.1° for his 276 medical students, tested in class between 8:00 and 9:00 A.M. (3). Individual means for our 29 subjects ranged

¹ Manufactured by E. Kessler, New York, N. Y.

TABLE 1
SIGNIFICANT VARIATIONS IN ORAL TEMPERATURE READINGS UNDER SPECIFIED CONDITIONS

Measure evaluated	Source of error estimate	Degrees of freedom	Components of error estimate	Significant variation ($^{\circ}$ F)	
				5%	1%
Any single reading in comparison with some hypothetical value, e.g., "normal temperature"	$S \times H \times D$	168	σ^2 (Sampling error: random trial-to-trial variations of readings after eliminating major sources of variability)	0.5	0.7
Difference between any two single readings	$S \times H \times D$	168	Same as above	0.7	0.9
Comparable readings made upon two individuals at same time of day; or two readings made upon one individual at same hour on different days	$S \times D$	56	$\sigma^2 + 4\sigma^2_{m(h \times d)}$ (Sampling error plus variation among 87 means representing 4 observations each)	1.2	1.5
Two readings made upon one individual at different hours, either on same day or on different days	$H \times D$	6	$\sigma^2 + 29\sigma^2_{m(h \times d)}$ (Sampling error plus variation among 12 means representing 29 observations each)	1.6	2.4

from 97.2 $^{\circ}$ to 98.5 $^{\circ}$; the 4 hourly means ran from a low of 97.5 $^{\circ}$ at 8:00 A.M. to a high of 98.2 $^{\circ}$ at 6:00 P.M., while the 3 daily means varied by less than 0.1 $^{\circ}$.

A conventional analysis of variance yielded mean squares significant at the 1% level or beyond for "between subjects," "between hours," and 3 interactions, "subjects \times hours," "subjects \times days," and "hours \times days." Significance of the first-order interactions was established by testing them against the residual variance or "subjects \times hours \times days" interaction; the main variables, "subjects" and "hours," were evaluated in terms of the appropriate first-order interactions. Furthermore, a series of Bartlett tests, applied to different groupings of the original data, justified certain assumptions concerning homogeneity of variance which would permit the use of all the interactions except, possibly, "subjects \times hours" in evaluating individual temperature readings. The latter is suspect for this purpose, because the variance "within hours," estimated from the 29 means of 3 daily readings each, appeared to differ significantly from one hour to the next.

Standard deviations representing the several sources of variation may be obtained by extracting the square roots of the mean squares resulting from the analysis of variance. Those derived from the 3 usable interactions were employed to establish the magnitudes of significant variations at the 5% and the 1% levels of confidence for a number of comparisons frequently made in practical work (4). These values are presented in Table 1, together with suggestions for their appropriate use and information concerning the components of the error estimate in each case (5). If, for example, any two readings differ by 0.9 $^{\circ}$ F or more, the chances are 99 in 100 that a real difference exists between the actual temperatures in question. If, however, the readings are made at different times of day, the difference must equal at least 2.4 $^{\circ}$ for the same level of confidence, since, in this case, a component of the hourly variation must be included in the error esti-

mate. In general, any given reading must deviate from some hypothetical value or from another reading by amounts as great as or greater than those shown in Table 1 before one may safely conclude that there is a significant difference in oral temperature itself.

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Use of the Thymus Gland in Chicks to Elucidate Interrelationships Between Pteroylglutamic Acid and Biologically Related Substances¹

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Sadun *et al.* (1) reported that a pteroylglutamic acid (PGA) deficiency in chicks infected with *Ascaridia galli*, the large roundworm of chickens, fed a highly purified semisynthetic diet resulted in atrophy of the thymus gland. At the time Sadun's studies were carried out, vitamin B₁₂ was unavailable and therefore

¹ Journal Article 1553, Michigan Agricultural Experiment Station. Portion of a thesis submitted by Gerald Brody to the Graduate Faculty of Michigan State College in partial fulfillment of the requirements for the Ph.D. degree. This research was supported by a grant from Lederle Division, American Cyanamid Co., Pearl River, N. Y.

² Present address: Research Department, Moorman Manufacturing Co., Quincy, Ill.

³ The author is indebted to William D. Lindquist for his valuable guidance in this project.

TABLE 1
EFFECT OF VITAMIN B₁₂, VITAMIN C, AND LEUCOVORIN
ON THE THYMUS GLAND IN PGA DEFICIENT
CHICKS INFECTED WITH
Ascaridia galli

Expt. no.	Diet	No. animals		Thymus weight
		Start	Fin- ish	
5	Basal (no PGA)	27	7	.063
	Basal + 200 µg PGA/100 g diet	14	14	.513
7	Basal (no PGA, no B ₁₂)	25	10	.104
	Basal + 5 µg B ₁₂ /100 g diet	24	8	.089
	Basal + 100 mg vitamin C/100 g diet	24	22	.088
	Basal + B ₁₂ + vitamin C	21	7	.197
	Basal + B ₁₂ + vitamin C + PGA	24	23	.597
10	Basal (no PGA, no B ₁₂)	20	7	.069
	Basal + B ₁₂	21	11	.131
	Basal + PGA	18	18	.380
	Basal + PGA + B ₁₂	14	14	.543
	Basal + 400 µg leucovorin/ 100 g diet	18	18	.531

it would seem that Sadun was actually working with a deficiency of both PGA and vitamin B₁₂. From this one might also assume that his control birds which were given adequate PGA were still deficient in vitamin B₁₂. Closely related to the biological activity of vitamin B₁₂ and PGA is leucovorin and vitamin C. It is currently believed that leucovorin is the active form of PGA (2), and that vitamin B₁₂ participates in the formation of leucovorin from PGA in chicks (3). Vitamin C on the other hand appears to be synergistic in nature. Dietrich *et al.* (4) reported that vitamin C enhanced vitamin B₁₂ activity and both vitamin C and vitamin B₁₂ stimulated *in vivo* synthesis of PGA.

In view of these intimate metabolic interrelations, studies were initiated to ascertain the effect of PGA, vitamin B₁₂, vitamin C, and leucovorin on *A. galli* infections and on the thymus gland of infected chicks. The action of these compounds on *A. galli* infections as well as complete information as to techniques employed and composition of the basal ration will be reported elsewhere (5). Day-old white leghorn chicks, obtained from a commercial hatchery, were used in all experiments. Chicks were infected at 2 wk of age and 3 wk later were autopsied. Thymus weights were obtained using a Roller-Smith balance and recorded as thymus weight/100 g body weight.

The dramatic atrophy of the thymus gland in the absence of PGA (Expt. 5) could be used to elucidate the interactions of PGA with other compounds. The addition of vitamin B₁₂ (5 µg/100 g diet) to a basal diet deficient in both PGA and vitamin B₁₂ had no consistent influence on thymic growth. Likewise the addition of vitamin C (100 mg/100 g diet) to this basal diet did not stimulate the growth of the thymus gland. However, the addition of both vitamin C and vitamin B₁₂ did increase the thymus weight but did not approach the level produced by the addition of

PGA (200 µg/100 g diet) to the diet (Expt. 7).

On the other hand, the relative weight of the thymus gland in the presence of leucovorin (400 µg/100 g diet) is almost equal to the weight level of the thymus gland in the presence of both PGA and vitamin B₁₂ (Expt. 10). The weight of the thymus gland in the presence of leucovorin is significantly greater than the weight produced by PGA alone, or by vitamin B₁₂.

As had been mentioned earlier, vitamin B₁₂ has no consistent effect on the thymus gland in the absence of PGA, but in the presence of PGA, vitamin B₁₂ significantly increased the weight of the thymus gland equal to the weight produced by leucovorin alone. Limited numbers of noninfected control chicks were run simultaneously in all 3 experiments with the same results reported herein. Using the weight of the thymus gland in chicks as a criterion, evidence is presented to support the concept that leucovorin is the active form of PGA and that leucovorin is biologically equivalent to PGA plus vitamin B₁₂.

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Report of a Second Example of the Rh Agglutinin *c'*, with Some Comments on Its Relation to the Agglutinin *f*¹

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The recent discovery of a new member of the Rh family of agglutinogens known as *f* (1) has raised several issues both of practical and theoretical importance. In a previous communication (2) the present authors reviewed the genetic theories which would most adequately explain the inheritance of the new factor and also made the suggestion that the antigen *f* might possibly be determined by a "position effect" (3) of the genes *c* and *e*. Essentially it was proposed that the presence on one chromosome of the gene combination *ce* would give rise to the *f* antigen in red cells. Replacement of either *c* or *e* by the alleles *C* or *E*, respectively, would destroy the position effect, and the *f* antigen would accordingly be absent from the cells. It was predicted that the replacement of the genes *c* or *e* by alleles which caused even minor modification of the corresponding cell antigens might be

¹ Research supported in part by Public Health Service Grant No. H 1227.

² Geneticist, Children's Cancer Research Foundation, Children's Medical Center, Boston.

as effective in destroying the position effect as alleles which caused a major change in these cell antigens.

Recently a series of blood samples have been obtained from a family of unusual genetic composition. In this family it was possible to follow the transmission of an allele of *c* (probably *c*^o) through three generations and to demonstrate that the association of this allele on the same chromosome with *e* did not give rise to the antigen *f*.

After delivery of an erythroblastic fetus the serum of the mother was found to contain an anti-Rh antibody with the specificity anti-D. This was her first pregnancy, but inquiry revealed the fact that she had received an intramuscular injection of her father's (Rh positive) blood about 18 yr previously. Other examples of this unfortunate situation have been described by Levine (4).

The blood of her husband (the propositus) was typed in an attempt to determine zygosity at the *Dd* locus, but since the results were not conclusive all other available relatives of the husband were typed with the 5 usual anti-Rh sera and also with anti-C^o and the new antibody anti-f. The results obtained from this investigation are in Table 1. It can be seen that

TABLE 1
REACTIONS OF BLOODS OF FAMILY UNDER INVESTIGATION
WITH FIVE USUAL ANTI-RH ANTISERA AND
ALSO WITH ANTI-C^o AND ANTI-f

Spec. No.	Relation to propositus	Reaction of blood with Rh antisera						
		anti-C	anti-C ^o	anti-D*	anti-E	anti-c	anti-e	anti-f
1	Father	+	0	+++	+++	+++	+++	0
2	Mother	+++	0	+++	0	0	+++	0
3	Brother	+++	0	+++	0†	+++	+++	0
4	Propositus	0	0	+++	0†	+++	+++	0
5	Wife	+++	0	0	0†	+++	+++	+++
6	Child	+	0	+++	0†	+++	+++	+++

Note. The symbols +++ and ++ indicate strong reactions. A weak but definite reaction is indicated by the symbol +, whereas a negative reaction is expressed as 0.

* Each specimen was tested with 2 different examples of anti-D, the negative result of specimen 5 being confirmed by the indirect Coombs' technic.

† These specimens were tested with 4 different examples of anti-E.

the father (specimen 1) of the propositus as well as the child (specimen 6) gave a weak reaction with the anti-C serum.³ This phenomenon suggested that the antigen determined by the *Cc* locus might in these individuals be due to an allele such as *C*^o or *c*^o (5). These two bloods were therefore investigated more fully from this point of view. Each specimen was tested with 7 different anti-C sera in addition to the one already used in the routine typing.

Table 2 gives the reactions obtained by this procedure together with the results of testing control *Cde/cde* and *cDe/cde* cells in parallel. The results established the fact that these two bloods contained

³ Experience with this serum has shown it to give very strong reactions with "normal" C antigens.

TABLE 2
REACTIONS OF BLOODS FROM FATHER OF PROPOSITUS
(#1) AND CHILD OF PROPOSITUS (#6)
WITH 7 ANTI-C SERA
(Control positive cells were of type *Cde/cde*; control
negative cells were of type *cDe/cde*)

Blood sample	Anti-C sera*						
	R 39	3149	And.	Ada.	101b	Bis.	Jac.
Family blood #1	±	++	0	0	+	0	+++
Family blood #6	+	++	0	0	+	±	+++
Control positive	+++	+++	+++	+++	+++	+++	+++
Control negative	0	0	0	0	0	0	0

Note. The Symbols +++, ++, +, ±, 0 represent varying strengths of agglutination from maximum strength through weaker grades to complete absence of clumping.

* These seven anti-C sera are different from each other and from the one previously used in routine typing.

an antigen which reacted with some, but not all, anti-C sera. This antigen was tentatively classified as *C*^o or *c*^o. This distinction between these 2 antigens depends on the demonstration of a "dosage" effect, it being known that the cells of an individual with the genotype *cc*^o behave as though they possessed 2 units of the antigen *c* while the cells of a person with the genotype *Cc*^o behave as though they possessed a single unit of *c*. A "dosage" titration was therefore set up in the manner recommended by Race and Sanger (6), using two different anti-*c* sera and assigning "scores" to the various strengths of agglutination. In these comparative titrations samples 1 and 6 from the family under investigation clearly showed the double dose effect (Race and Sanger score 50), behaving more like the *cde/cde* control blood (Race and Sanger score 48) than like the control *CDe/cde* blood (Race and Sanger score 35). The C variant present in these individuals thus behaved like the variant *c*^o of Race, Sanger, and Lawler (5) rather than their variant *C*^o. It now became possible to construct an accurate genealogy of the Rh chromosomes in this family, as shown in Fig. 1.

The criteria defining genes allelomorphic to *C* were laid down by Race, Sanger, and Lawler in 1948 (5). The family described by us represents the second example of *c*^o and is the first demonstration of its transmission through three generations.

It is of interest to explore the relationship of the allele *c*^o to the antigen *f*. It was originally shown by Rosenfield *et al.* (1) and confirmed by the present authors (2) that there is a very close association between the genes *c* and *e* and the antigen *f*. The nature of this association was such that the antigen *f* was not present in the red cells unless an individual possessed a chromosome bearing the genes *c* and *e* (that is, the chromosomes *cde* and *cDe* or, more strictly positionally, *dce* and *Dce*). The association with the *ce* gene combination, while close, was found not to be invariable, 3 examples out of a total of 35 *CDe/cde* random bloods being *f* negative in our series. The antigen *f* has not been detected up to the present time in the absence of the *ce* gene combination.

Rosenfield *et al.* suggested that the inheritance of the *f* antigen could be explained by the postulation of a pair of allelic genes *Ff* closely linked to the pairs *Cc*, *Dd*, and *Ee*. Chromosomes known to confer the antigen *f* on the cells would therefore be *cdef* and *cDeF*, while typical examples of chromosomes not associated with the presence of *f* would be *CDeF*, *cDEF*, *CdeF*, etc. Implications of this hypothesis are that there should exist an antigen *F* and a corresponding antibody anti-*F*; also it would be expected that chromosomes such as *cdeF* and *CDeF* would exist. The

In this family there are three individuals (the propo-
situs, his father, and his brother) who are *f* negative
and who possess the chromosome *cDe*. The daughter
of the propo-
situs who is *f* positive also possesses the
chromosome *cDe*, but it is apparent that her *f* antigen
is derived from the *cde* chromosome which she in-
herited from her mother.

The data provided by the analysis of the bloods of
this family lend support to the "position effect" hy-
pothesis, although they do not contradict the postula-
tion of a fourth locus in the Rh complex; nor, for
those who favor it, do they invalidate an extension of
the multiple allele hypothesis.

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Fatty Acid Absorption and Chylomicrons

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The absorption pathway of long-chain fatty acids
is still controversial. Frazer (1,2), working with rats,
found that ingested oleic acid did not give rise to
chylomicronemia and, therefore, reasoned that the ab-
sorption pathway of the fatty acid was through the
portal system. However, Bergstrom *et al.* (3), Bloom
et al. (4), Reisner (5), and Tidwell (6), have been
unable to confirm this view.

Our attention was drawn to this controversy because
of our interest in the effect of bile salt on lipid ab-
sorption. In a previous communication (7), it was
shown that a neutral fat would give rise to chylomicro-
nemia when absorbed from a Thiry fistula that con-
tained no bile or pancreatic secretion, implying that
neither was necessary for particulate fat absorption.
If it could be shown that a fatty acid does give rise
to chylomicronemia when placed into a Thiry fistula,
a similar interpretation as with the neutral fat ex-
periments could be made.

To study oleic acid absorption, 3 different types of
experiments on dogs were designed. In the first, the
fatty acid was ingested by the animals; in the second,
the acid was placed into a jejunal Thiry fistula; and
in the last, the fatty acids with a bile salt were put
into a Thiry fistula.

The 3 Thiry jejunal fistula dogs were the same ani-
mals studied previously (7). In all experiments, 10 ml
of c.p. oleic acid was used, as this amount of neutral
fat has been shown to give rise to a significant chylo-

¹ Supported by the Otto Baer Fund. The Department is in
part supported by the Michael Reese Research Foundation.

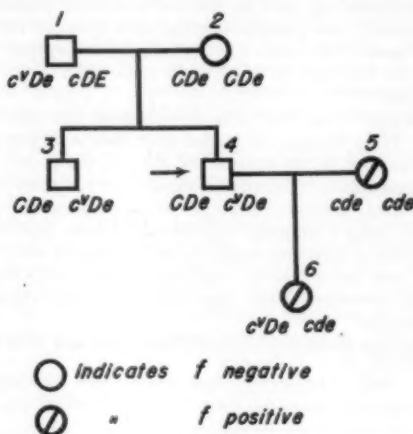


FIG. 1.

finding of *cde* chromosomes which were not associated
with the antigen *f* supports in some measure the
fourth locus hypothesis, these chromosomes presuma-
bly being *cdeF*. The failure to find chromosomes such
as *CDeF* and *cDEF* does not detract at this stage from
the hypothesis, since it can be presumed that these
chromosomes are rare.

The present authors suggested that another possible
explanation of the data "would consider the *f* antigen
to be the result of a 'position effect.' This hypothesis
would state that when the genes *c* and *e* are together
on the same chromosome the antigen *f* is present in the
red cells" (2). It was further postulated that the
"exceptions," that is, instances in which *c* and *e* are
apparently on the same chromosome and the antigen *f*
is absent, are due to the presence of alleles of *c* or *e*
which fail to interact to produce *f*. The "position
effect" hypothesis suffers the defect that it can be
proven only if a crossover occurs in which the genes
c and *e* are separated and at the same time the *f* an-
tigen is lost. Such a crossover would simultaneously
prove the truth of the Fisher-Race hypothesis of the
inheritance of Rh antigens. The discovery of an anti-*F*
serum would immediately invalidate the "position
effect" hypothesis, as would the discovery of the *f* an-
tigen in the absence of the genes *c* or *e*.

The family reported in this study is an example of
a situation predicted by the "position effect" theory.

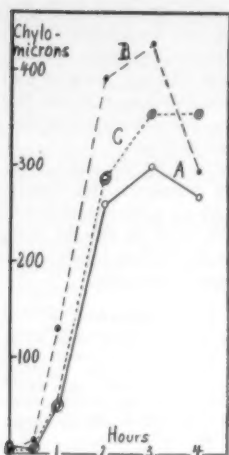


FIG. 1. Oleic acid absorption from Thiry loops in dogs. Curve A, 10 ml of oleic acid in Thiry loop; curve B, 10 ml of oleic acid + 1 g sodium taurocholate in Thiry loop; and curve C, 10 ml of oleic acid by mouth.

miconemia (7). The bile salt used was sodium taurocholate, 1 g was mixed with the oleic acid before being placed into the fistula.

into the loop and continuing for 4 hr. Curve C shows that absorption of oleic acid given by mouth and consequent chylomicronemia occurred, and that they were of somewhat greater magnitude than when the fat was placed into a Thiry fistula. The addition of bile salt (Curve B) gave rise to greater degree of chylomicronemia, especially when compared to absorption of oleic acid from a Thiry fistula in the absence of bile.

The demonstration that oleic acid gives rise to chylomicronemia when given by mouth or when placed into a Thiry fistula implies that a long-chain fatty acid or its products can and do use the lymphatic pathway. Because it was possible to show that systemic chylomicronemia will result from fatty acid absorption, the role of bile salt in fatty acid absorption could be studied.

Riegel *et al.* (8), who investigated this problem with Thiry fistulae, concluded that oleic acid will not be absorbed in the absence of bile. Virtue *et al.* (9) disagreed and stated that if the salt of the fatty acid was used, absorption could be demonstrated. Our work, using a different approach, indicates that oleic acid can be absorbed easily in the absence of bile. The fact that the degree of chylomicronemia was greater in the presence of bile may mean that bile enhanced absorption.

The demonstration that oleic acid gives rise to chylomicronemia implies that its absorption pathway from the intestinal tract is through the lymphatics. Bile salt is not necessary for long-chain fatty acid absorption, but it may enhance it.

TABLE 1
ABSORPTION OF OLEIC ACID AND CHYLOMICRONEMIA

Substance and procedure		Hours after administration and chylomicron counts					
		0	1/2	1	2	3	4
A. Oleic acid in Thiry fistula; 10 expts.	Average	9	6	51	261	298	267
	Range	1-28	1-23	1-234	1-400	8-600	96-600
B. Oleic acid and bile salt in Thiry fistula; 9 expts.	Average	7	14	131	392	428	295
	Range	1-13	1-75	1-350	200-750	200-650	29-750
C. Oleic acid/os; 10 expts.	Average	7	7	53	238	356	356
	Range	0-34	0-24	2-159	24-500	42-850	12-850

Because of its insolubility, only 3-5 g of sodium oleate could be placed into a Thiry fistula, a quantity that would not give rise to chylomicronemia.

All chylomicron counts were made by one observer, as previously described (7). The counting error was 20%. Absorption of the fatty acid introduced into the Thiry fistula was confirmed also by observations on its disappearance from the Thiry loop.

The results of each group of experiments were averaged, and from these averages the curves in Fig. 1 were constructed. Table 1 gives the numerical averages and their spreads.

Curve A, Fig. 1, shows that oleic acid gave rise to chylomicronemia starting 1 hr after the fat was placed

into the loop and continuing for 4 hr. Curve C shows that absorption of oleic acid given by mouth and consequent chylomicronemia occurred, and that they were of somewhat greater magnitude than when the fat was placed into a Thiry fistula. The addition of bile salt (Curve B) gave rise to greater degree of chylomicronemia, especially when compared to absorption of oleic acid from a Thiry fistula in the absence of bile.

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Comments and Communications

Methionine Content of Teosinte

MELHUS, Aguirre, and Scrimshaw [SCIENCE, 117, 34 (1953)] have stated that "from the data presented teosinte should be further studied as a potential source of vegetable protein of relatively high methionine content." However, the data presented do not show any such thing. From a comparison of the methionine/nitrogen ratios it will be seen that the protein of teosinte is just about as deficient in methionine as the protein of maize. Consequently, because of well-known laws of amino acid nutrition, teosinte could hardly be expected to correct a methionine deficiency, any more than a higher level of maize in the diet would correct it.

The ultimate solution to the problem of correcting methionine deficiency in the vegetable protein diets of humans in underdeveloped areas appears to lie in a different direction. Nutritionally available synthetic methionine can be produced in unlimited quantities. It is already so cheap that it is widely used in chicken feed. Surely a way could be found to take advantage of the availability of synthetic methionine for correcting human dietary deficiencies as well.

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Received January 16, 1953.

WHEN calculated on the basis of 16% nitrogen the four teosintes described average 2.25 mg % methionine and the two corns 1.68 mg %. Thus, part of the superior methionine content of teosinte when it is reported on the basis of 10% moisture is due to the higher total protein content, but not all of it, as Dr. Patton implies. The data presented enabled the reader to make the calculation of methionine content on a 16% nitrogen basis (or estimate the methionine/nitrogen ratio) if he were especially interested. However, we regret that we did not present the data both ways in the table in order to avoid any misunderstanding.

Even if there were no difference on an equal protein basis, teosinte would still be potentially useful in improving the methionine content of Guatemalan diets. Many adults consume 500 g of whole corn daily, prepared as tortillas, obtaining thereby as high as 80% of their calories and 70% of their total protein. This quantity of corn supplies approximately 63% of the methionine requirement (Aguirre, Robles, and Scrimshaw: "The Nutritive Value of Central American Corns. II. Lysine and Methionine Content of Twenty-three Varieties in Guatemala." *Food Research*, in press.). The extent to which the requirement is further met by the cystine in corn is still under investigation. When teosinte is substituted for corn or mixed with it, it replaces an equal weight of corn. Thus any significant use of teosinte in the preparation of tortillas would increase the methionine in the diet without a

significant change in dietary habits on the part of the people.

We have emphasized the improvement of diets rather than the use of synthetic nutrients, no matter how cheap and plentiful, because the Guatemala Indian culture with its independence, isolation, economic rigidity, and conservatism makes their introduction highly impractical. Whether synthetic methionine might be of value in some other underdeveloped areas is beyond the scope of this discussion, but the practical difficulties in the way of its introduction, distribution, and control would appear formidable.

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The "Great Fireball Procession" of 1913

IN C. C. Wylie's account of the "great fireball procession" of 1913 (SCIENCE, 118, 125, 145 [1953]), it is perhaps not made sufficiently clear that this description of the phenomenon differs considerably from that which has previously appeared in the astronomical literature. The version of the event so severely criticized by Professor Wylie is not (as readers of his article might tend to assume) a post-factum "popular" accretion, but is that presented in the original report on the occurrence by C. A. Chant of Toronto, the editor of the *Journal of the Royal Astronomical Society of Canada* (1). Subsequent writers on the event (2, 3) saw no grounds for questioning Chant's treatment, and were even able to unearth further data of a strongly confirmatory character (4, 5). Professor Wylie's statement that closer study reveals the facts to have been entirely different from what these astronomers thought them to be is therefore more novel and surprising than his rather casual reference to the matter might lead the reader to suppose. What Wylie in 1953 confidently identifies as "an excellent shower of shooting stars" was positively stated by Pickering in 1922 (3) to have been "in no sense a meteor shower, but a different kind of event altogether."

It is to be hoped that Wylie's new interpretation will soon be supported by a more formal publication with citation of evidence, since at present it must be acknowledged that it is difficult to connect the description given by him with the original observations as published by Chant (*loc. cit.*). These very numerous reports unanimously described a unique procession, lasting for three minutes, of a great number of bright fireballs in clusters moving slowly and strictly horizontally. Wylie's description of the event as local in character is likewise a revision of the previously accepted version and is not easy to reconcile with the data. An extraordinary fireball procession moving

from northwest to southeast was seen successively in Saskatchewan, in Ontario, over the North Atlantic, in Bermuda, and finally by a ship in mid-Atlantic south of the Equator (2, 4, 5). These successive appearances defined a trajectory (roughly a great circle) 5200 miles long. "A very few fireballs or shooting stars observed in other places" does not seem to be an adequate summary of this situation. If it is to be argued that these successive appearances of a unique phenomenon were due to mere coincidence, strong evidence will have to be adduced.

A fully satisfactory explanation of this spectacular occurrence of 1913 has never been achieved. Wylie's proposal to explain it as simply an ordinary event which was misinterpreted is, at least, a fresh approach. However, it should be recognized that the recorded evidence is difficult, if not impossible, to reconcile with Professor Wylie's description.

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UNDER date of April 29, 1953, I wrote the editor of *Sky and Telescope*, Harvard College Observatory, suggesting that in view of the sensational features appearing in popular magazines on the meteors of February 9, 1913, it might be well to publish another article giving a more factual account of the occurrence. The editor replied that since he had published in March, 1952, an article by Professor Pruett, of Oregon, in which it was shown that the popular version was impossible, he thought another article at this time was not necessary; but he added, "Perhaps in a couple more years it would be interesting to remind people of the situation once again."

Professor Chant, of the University of Toronto, published some 140 reports by observers of these meteors (1), but not being a meteor man he accepted the popular version although he had difficulty fitting the observations to the supposed path. A meteor man would have interviewed a few observers of the display within twenty-four hours of the occurrence, and determined the radiant from a plot of the reported paths.

Calculations made from the data published by Chant were made and published later (2, 3), however, and show the following.

1) A fireball as bright as the brightest reported by Chant, and traveling at the height and speed of the popular version, would survive only a few miles, instead of the supposed 5000 miles, against the resistance of the air.

2) None of the more than one hundred reports mention seeing a fireball either rise from, or drop

behind, objects on the horizon. As this has been reported regularly for fireballs with path lengths of say 100 miles, none of the 1913 meteors can have had a path length greatly in excess of 100 miles.

3) The popular version assumes a path passing close to the cities of Regina, Winnipeg, Duluth, Toronto, Buffalo, Rochester, and New York. At Toronto, Professor Chant was called by telephone immediately after the display, and scores of letters were received from Toronto and the adjacent territory. No reports were received from any of the other cities.

To show what might be expected, a single moderately bright fireball falling at 6:30 P.M. on September 28, 1953, was reported by newspapers in Philadelphia, Harrisburg, Baltimore, Scranton, Binghamton, and elsewhere. It is inconceivable that the "procession" of the popular version would have passed unnoticed all of the cities excepting Toronto.

4) The information published by Chant is quite sufficient for a determination of the radiant, or the direction from which the meteors came. The meteors in the Toronto area were falling downward at an angle of about 20° , and traveling roughly in the direction of Washington, D. C., instead of horizontally and toward New York City as the popular version requires.

5) The reports published by Professor Chant show, for the supposed path over North America, only one object bright enough to be called a fireball. This moderately bright object disappeared at a height of about 25 miles near Hamilton, Ontario. The other meteors were definitely in the class of ordinary shooting stars.

To summarize, the meteors of February 9, 1913, were a shower of shooting stars, plus a bright fireball in the Toronto area. Compared with other fireballs and meteor showers, they attracted relatively little attention outside of the Toronto area. The study of Chant's fundamental data was accepted at once as conclusive, in both Europe and America, and since its publication astronomers have not included the popular version in either textbooks or popular articles.

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Erratum. In the article "Newer Synthetic Structures of Interest as Tuberculostatic Drugs," *SCIENCE* 118, 497 (1953), an error appeared in the data in Table 1, p. 501. Under the heading "Approx. dose, mg/kg," in column 1, the figure should be 50 in every case instead of 125. These data were culled from the publication by Grunberg and Leiwant (21) and the error in translation can be ascribed to sheer inadvertency.

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Book Reviews

Exploration Hydrobiologique du Lac Tanganika (1946-47): Résultats Scientifiques. Vol. I: *Le Milieu Géographique et Géophysique* by André Capart, *Le Milieu Biochimique* by Jean Kufferath, *Le Milieu Végétal* by Ludo Van Meel, *Les Invertébrés* by Eugène Leloup, *Les Vertébrés* by Max Poll, 168 pp., illus. + plates. Vol. II, fasc. 1: *Relevé des Stations* by Eugène Leloup, 119 pp., plates + maps. Vol. II, fasc. 2: *Sondages et Carte Bathymétrique* by André Capart, 16 pp., plates + maps. Vol. III, fasc. 1: *Lamellibranches* by Eugène Leloup, 153 pp., illus. + plates. Vol. III, fasc. 2: *Trematoda, Cestoda and Acanthocephala* by Stephen Prudhoe, *Coleoptera Carabida* by Pierre Basilewsky, *Bryozoaires* by Adrianus W. Lacourt, *Méduses* by Eugène Leloup, *Cyclopides (Crustacés copépodes)* by Knut Lindberg, 91 pp., tables + plates. Vol. III, fasc. 3: *Amphibiens et Reptiles* by Gaston de Witte, *Hemiptera Homoptera* by Victor Lallemand and Henri Synave, *Coleoptera Lamellicornia* by André Janssens, *Crustacés Décapodes, Brachyures* by André Capart, 67 pp., illus. Vol. III, fasc. 4: *Gastéropodes* by Eugène Leloup, 273 pp., illus. + plates. Brussels: Institut Royal des Sciences Naturelles de Belgique, 1949-53.

Expédition Océanographique Belge dans les Eaux Côtières Africaines de l'Atlantique Sud (1948-49): Résultats Scientifiques. Vol. I: *Annexe: Liste des Stations* by André Capart, 65 pp., illus. Vol. II, fasc. 1: *Etude Physique et Chimique du Milieu Marin* by Charles Van Goethem, 152 pp., illus. Vol. III, fasc. 1: *Cumacés* by Louis Fage, *Crustacés Décapodes, Brachyures* by André Capart, 205 pp., illus. + plates. Vol. III, fasc. 2: *Crustacés Décapodes, Macrures* by Lipke Bijdeley Holthuis, 88 pp., illus. Vol. III, fasc. 3: *Céphalopodes* by William Adam, 142 pp., illus. + plates. Vol. IV, fasc. 1: *Poissons: Généralités, Sélaciens et Chimères* by Max Poll, 154 pp., illus. + plates. Brussels: Institut Royal des Sciences Naturelles de Belgique, 1951-52.

It is good to know that in a few places in the world, in this day of inelegant offset and muddy mimeographing, the tradition of fine printing in science is still observed: that some people are still of the old-fashioned opinion that if an expedition is worth financing at all, its reports are worth publication in a suitable manner. Here are two series, both in folio format, on excellent paper with spacious margins, illustrated by excellently reproduced photographs and drawings.

Of the two expeditions, that to Lake Tanganyika is the more significant. When completed, this series will be a contribution to limnology which should make Americans blush with shame whenever they look at their neglected but much more accessible Great Lakes. One of the most interesting aspects of Lake Tangan-

yika is its gastropod fauna, and this is reported by Leloup in one of the most significant issues of the series, with tables of measurements and illustrations showing the range of variation of many of the species.

The results of the expedition to the coastal waters of west Africa (from the equator to Walvis Bay) will provide much valuable information on a particularly interesting and significant coastal region, and the faunal reports are presented in satisfactory detail. As this was primarily an expedition to study fish, it is perhaps unfair to ask for a more detailed physical and chemical report than the one before us, but a more intensive study of the Walvis Bay region in particular would have added greatly to the value of the report.

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The Biology of Paramecium. Ralph Wichterman. New York-Toronto: Blakiston, 1953. 527 pp. Illus. \$9.00.

Tennyson, in his "Flower in the Crannied Wall," expressed the faith that a thorough understanding of one organism would go far toward a general understanding of life. This is the tacit working philosophy of many biologists. It has created a need for a new kind of treatise, summarizing knowledge and supplying full bibliography about a particular organism. Wichterman's book on *Paramecium*, belonging to this class, is indispensable for investigators working on *Paramecium* or similar organisms.

Studied for nearly 300 years and long enjoying the status of a laboratory favorite in many and varied fields of biology, *Paramecium* is the subject of a very large number of papers. Approximately 2000 references are cited in Wichterman's book, more than twice as many as in the 1931 book on the same subject by Kalmus. The bibliography alone confers upon the book great value to researchers and students, and this value is enhanced by the text, which is a helpful introduction to the literature.

The 432 pages of text (exclusive of bibliography and indices) are roughly distributed as follows: about 100 pages on classification, morphology, collection, culture, and sterilization; about 150 pages on physical and chemical properties and physiology; about 100 pages on reproduction, cytology, genetics, and sexuality; and the remaining 80 pages on vitality and the life cycle, serology, parasites, techniques, and problems.

A student of *Paramecium* for more than 20 years, Wichterman has used his unsurpassed acquaintance with the literature to portray it faithfully. Unfortunately, however, the literature includes a great deal that is in need of more than faithful portrayal. To be sure, it includes the works of a number of acute

observers, rigorous experimenters, and logical and imaginative thinkers, such as R. Hertwig, Maupas, and Jennings, among those no longer alive. But it also includes a very large amount of nonsense. This in considerable measure stems from observers, often excellent observers, who are innocent of the rigorous basis, experimental or logical or both, required for drawing sound conclusions and who commonly appear to be unaware that their conclusions are not obvious consequences of, or even identical with, their observations. Perhaps Wichterman conceived his task to be primarily to inform his reader of what the literature contains, not to sit in judgment on it. That he is capable of analysis, synthesis, and judgment, however, is repeatedly shown in the book (for example, the discussions of the status of autogamy and of taxonomy). It is greatly to be regretted that a similar approach was not consistently followed throughout the book and in all its details. Nevertheless, the book is a mine of information which will doubtless prove interesting, stimulating, and fruitful to investigators and students as it has already to the reviewer.

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Low Temperature Physics: Four Lectures. F. E. Simon *et al.* New York: Academic Press; London: Pergamon Press, 1952. 132 pp. Illus. \$3.50.

These four nonmathematical lectures, by outstanding research experimentalists in the field of low temperature physics, were originally given at the Royal Institution, London, in the winter of 1950 as a short course for young students preparing to specialize in the field and as a general survey for those whose interest in low-temperature physics is less direct.

The style of the lecture is maintained by all four writers. Useful bibliographies and references have been appended. As the publication followed some two years after the lectures were given, reports on work of more recent date than 1950 are included, notably on the achievement of nuclear alignment at low temperatures in 1951 (see lecture 2).

The first lecture by F. E. Simon, Professor of Thermodynamics in the University of Oxford, is a general survey. In it he surveys the general principles of attaining low temperatures and the significant role played in such considerations by the third law of thermodynamics, which he describes as the most important guiding principle in low-temperature research. He makes a brief outline of the importance of the zero point energy in the behavior of liquid helium and of electrons in metals, and sketches the significance of low-temperature research to our understanding of many of the thermal, mechanical, and magnetic properties of matter, including those concerned with the general phase diagram of fluids. Although this general outline of necessity is short, it is well balanced and serves as an excellent background for the three succeeding lectures.

The second lecture by N. Kurti, also of the University of Oxford, is on the temperature range below 1° absolute. In it the author justifies the separation of this particular range of temperature from other ranges of low-temperature research mainly on the grounds that it is approachable generally only by magnetic cooling methods. He then describes the method of magnetic cooling using paramagnetic salts, giving interesting practical information and giving some data on the properties of the salts themselves. A longer section is devoted to the possible techniques to be used for future nuclear magnetic cooling, for obtaining temperatures still lower than those reached using paramagnetic salts. To date, however, such nuclear cooling has not been achieved. The lecture gives a satisfactory general introduction to the extensive work that has been done in the temperature range below 1° K during the past two decades.

The third lecture, entitled "Liquid Helium," by J. F. Allen, Professor of Natural Philosophy in the University of St. Andrews, gives a nonmathematical description of the main properties of the fluid. The phase diagram and the significance of the zero point energy are first discussed, and then the main transport and film properties of the superfluid phase are presented and discussed in the light of the current two fluid model of the liquid. In such a brief outline many interesting features, as, for example, that of second sound, could be treated only lightly; nevertheless, no items of fundamental importance have been omitted. The lecture should stimulate its readers to further study of the many interesting facets of the problem of liquid helium.

Superconductivity forms the subject of the fourth lecture by K. Mendelssohn, also of the University of Oxford. The author has compressed the more significant results of over 40 years' work by a great number of investigators on the phenomenon of superconductivity into one very readable lecture. He outlines the salient experimental features of superconductivity, namely the distribution of the effect among elements and alloys, the magnetic properties, the magnetic penetration depth, heat conductivity, etc. He devotes a larger section to the thermodynamics of the effect and the resulting thermal data that can be obtained therefrom and another to interesting transition phenomena such as time effects. It is not surprising that with so much compression of material, only a cursory statement is made of the theoretical problems involved.

All four lectures maintain an even level among themselves and are presented in a manner easily assimilable by nonspecialist students. For a quick glance at many of the important and active branches of current low-temperature research, they form an accurate and authoritative introduction. Moreover, the bibliographies and references accompanying each lecture serve as useful guides for more detailed study.

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We have a large number of such distributors scattered from Atlanta to Zurich. They are very helpful to people who prefer, at no extra cost, to do their business with a human face rather than with a squiggle at the bottom of a letter or a squawk from a telephone. In this case the man in Montreal had a friend who wanted to know if we could make some *N,N'*-Diethylsulfanilamide. We could. Thus was born Eastman 6900 and an abstract of how to use it in the assay of thyroxine.

Eastman 6900 costs a dollar a gram; the abstract is free. For either, both, or a copy of our catalog that lists more than 3500 Eastman Organic Chemicals, write to Distillation Products Industries, Eastman Organic Chemicals Department, Rochester 3, N. Y. (Division of Eastman Kodak Company).



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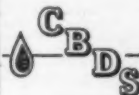
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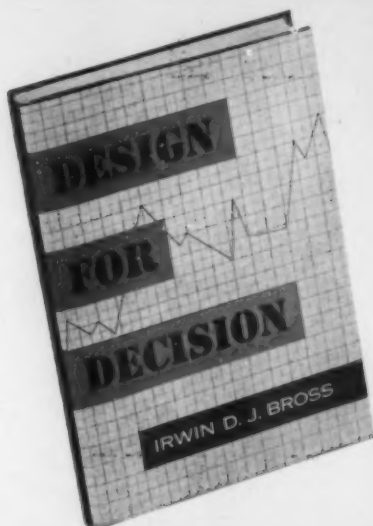
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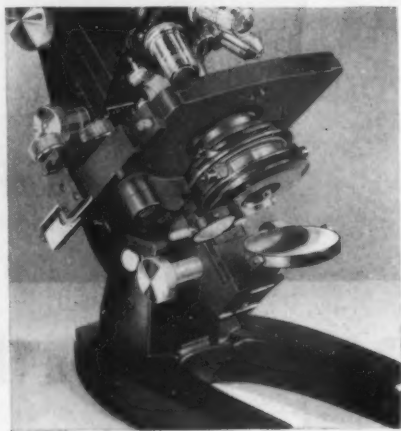
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